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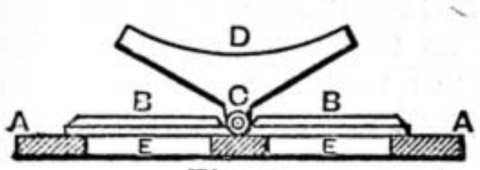

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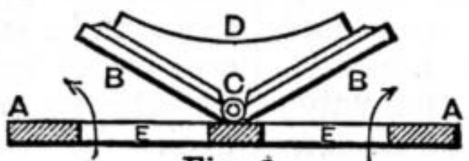

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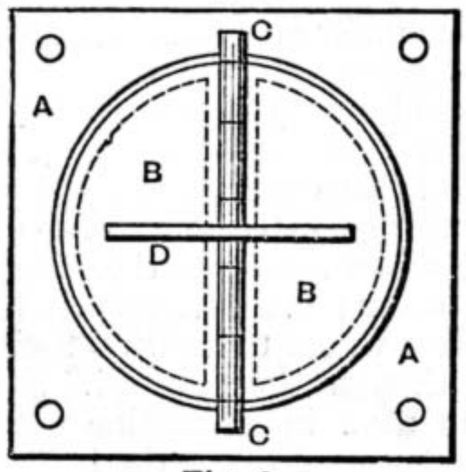

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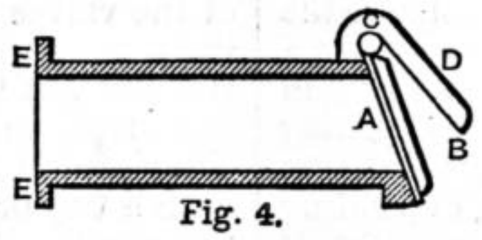

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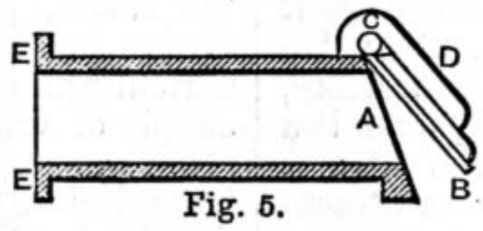

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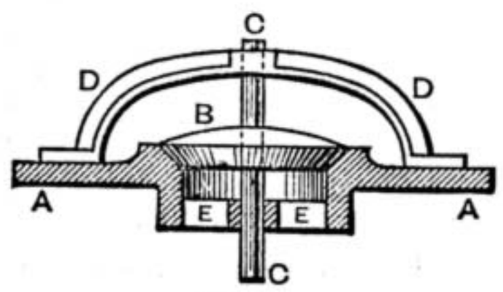

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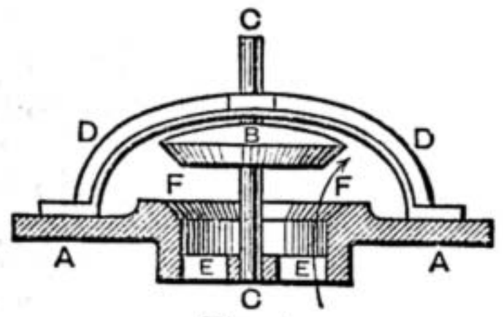

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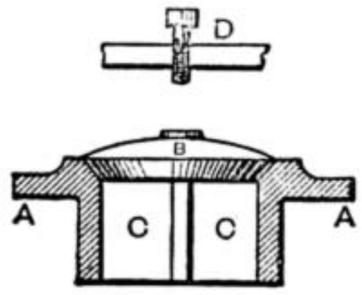

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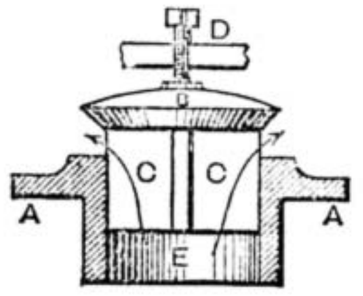

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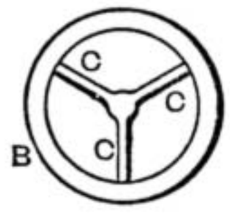

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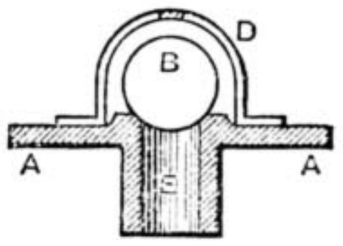

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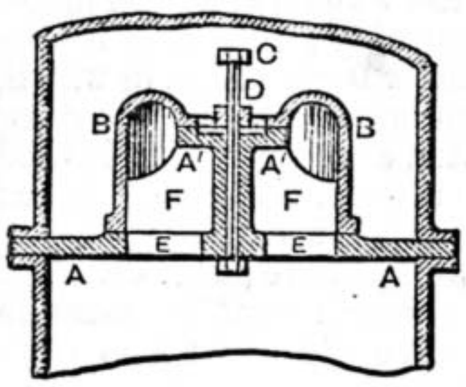

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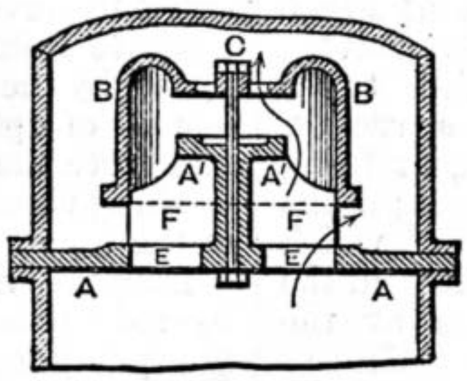

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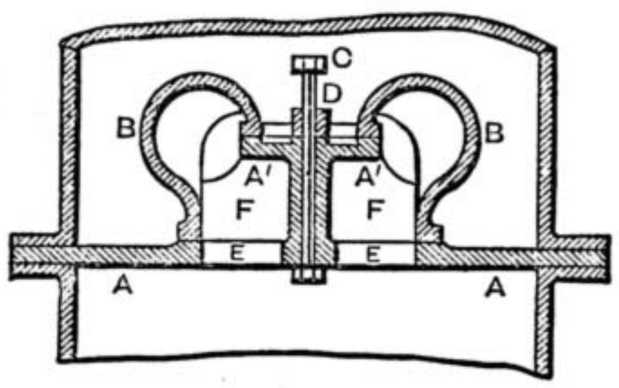

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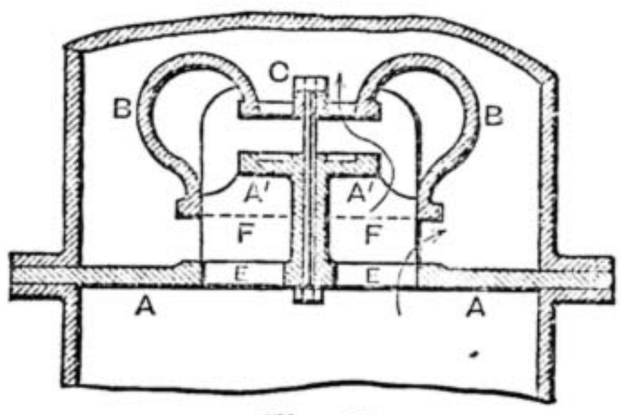

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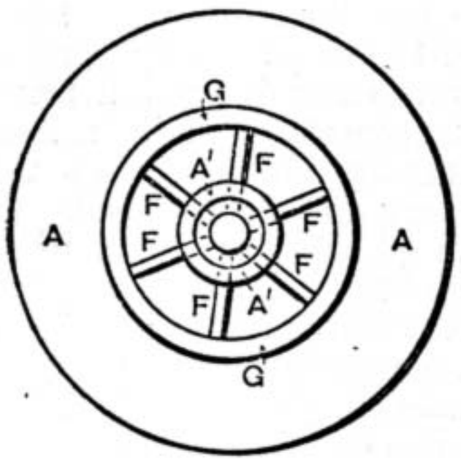

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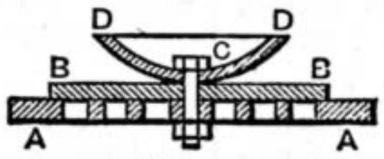

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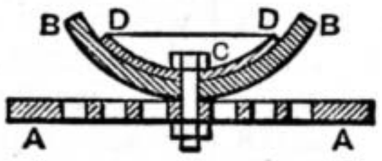

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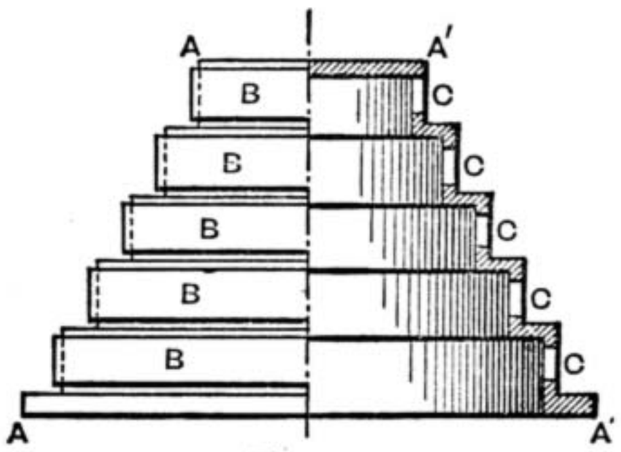

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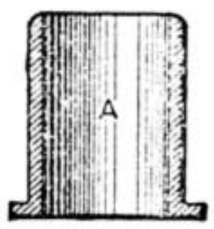

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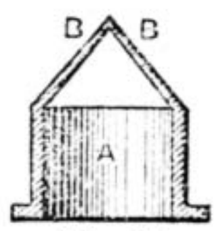

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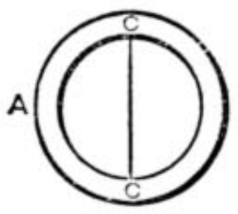

Fig. 22.

Fig. 1.—Butterfly Valve Shut: Seat in Section. Fig. 2.—Butterfly Valve Open: Seat in Section. Fig. 3.—Butterfly Valve: Plan. Fig. 4.—Flap Valve Shut: Seat in Section. Fig. 5.—Flap Valve Open: Seat in Section. Fig. 6.—Stem Valve Shut: Seat in Section. Fig. 7.—Stem Valve Open: Seat in Section. Fig. 8.—Stalk Valve Shut: Seat in Section. Fig. 9.—Stalk Valve Open: Seat in Section. Fig. 10.—Stalk Valve: Underside. Fig. 11.—Ball Valve: Seat in Section. Fig. 12.—Vertical Section of Double Beat Valve Shut. Fig. 13.—Vertical Section of Double Beat Valve Open. Fig. 14.—Plan of Seats of Double Beat Valve. Fig. 15.—Vertical Section of Crown Valve Shut. Fig. 16.—Vertical Section of Crown Valve Open. Fig. 17.—Flat Indiarubber Valve Shut. Fig. 18.—Flat Indiarubber Valve Open. Fig. 19.—Indiarubber Band Valve, half Elevation and half Vertical Section. Figs. 20 and 21.—Vertical Sections, at Right Angles to each other, of Indiarubber Semi-Lunar Valve. Fig. 22.—Plan of Indiarubber Semi-Lunar Valve.

PUMP VALVES.

BY FRANCIS CAMPIN, C.E.

BUTTERFLY VALVES—FLAP VALVES—STEM VALVES—STALK VALVES—BALL VALVES—DOUBLE BEAT VALVES—CROWN VALVES—FLAT INDIARUBBER VALVES—INDIARUBBER BAND VALVES—INDIARUBBER SEMI-LUNAR VALVES.

ALTHOUGH in machines of all descriptions every part should be carefully designed and accurately made, and therefore all parts may be regarded as of equal importance, yet are we apt to consider certain details as requiring greater care in their execution than some other parts, those details being such as readily show any defects when in action. So long as a machine can get through its work without any obvious irregularity appearing, dissatisfaction will not arise, although hidden imperfections may exist which materially reduce the efficiency of the apparatus. In pump-work, the weak point lies in the valves, and, therefore, some practical remarks on their construction and duties may prove of service to those who are interested in the details of hydraulic and pneumatic machinery.

The duty of a valve being to allow the passage of a fluid or liquid in one direction only, it is evident that the parts in contact when the valve is shut should fit so exactly as to preclude the passage between them of any of the liquid operated upon, and there are several ways by which this end is sought. If one of the faces is made of some elastic pliable material, such as indiarubber, it will, by adapting its form to that of the hard face with which it is brought in contact, form an air or water-tight valve with any reasonably true surface; but if both the valve and its seat are hard and unyielding, the surfaces of contact must be made exact counterparts of each other in order that they may work satisfactorily.

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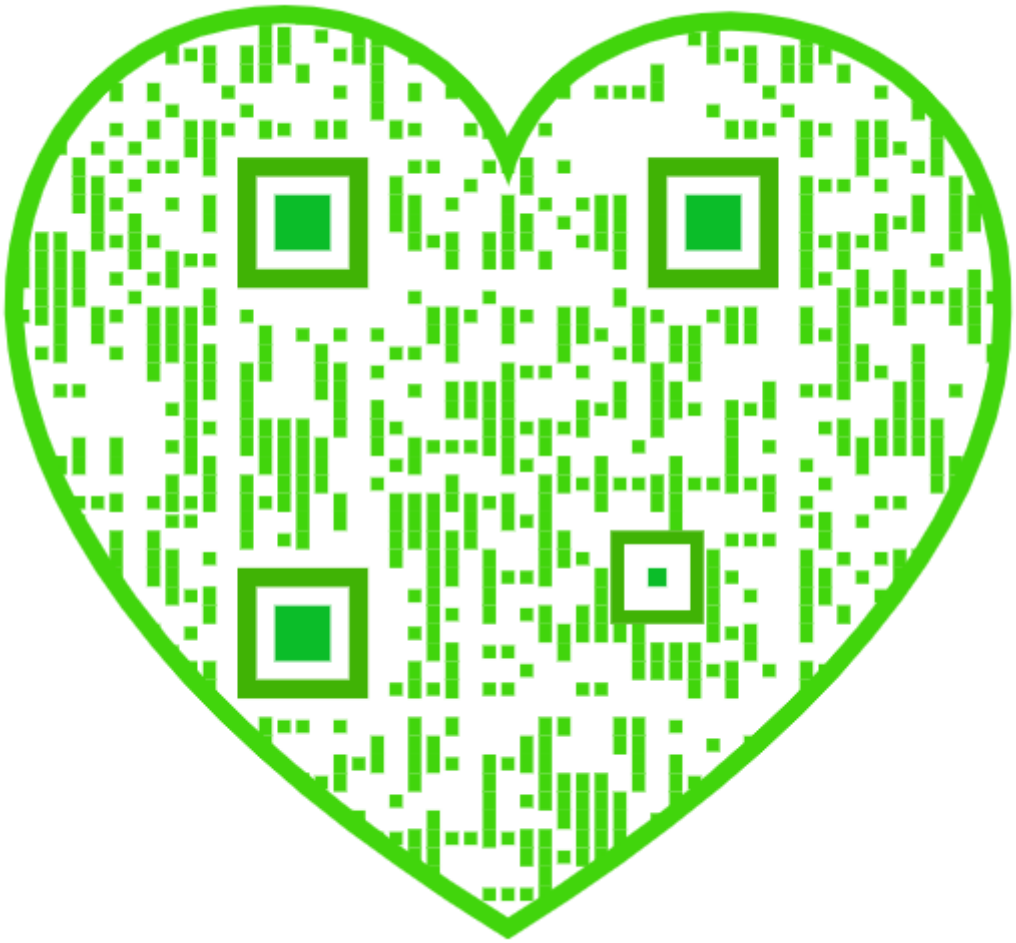

With regard to all surfaces of special forms, these may be fitted by grinding together with fine emery and finishing off with crocus powder, but to flat surfaces a different process should be applied. The mechanical method of preparing a plane surface is as follows:—In the first place, the surface is made as true as the planing machine or lathe will render it. The surface thus prepared is tested by laying it upon a rigid plate having a true surface, on which a little ruddle has been smeared; the plate used for this purpose is called a surface plate, and is one of the most important gauging tools in the shop. Any parts in the surface under manipulation that are higher than the general level will naturally, by their contact with the surface plate, raise the rest of the work from it, so that the highest parts only will be marked with the ruddle; a slight movement of the work upon the surface plate will effect this marking. The work being then turned over on to the bench, the marked parts are carefully scraped down (a very good scraper can be made from an old three-square file, by grinding the cuts out at the end so as to form three curved scraping edges—not cutting edges) and the work is again applied to the surface plate. More parts will now be found to be marked, and these are to be scraped down as before; at every application it will be found that the marking will extend more continuously over the surface under treatment until at last a uniformly even surface is produced, and both the valve and its seat being thus prepared, a perfectly tight contact may be anticipated.

For very large surfaces I should say that it becomes necessary to apply the surface plate to the work, small ones, easily handled, being made for this purpose. As perfect rigidity is absolutely indispensable in surface plates, they are strengthened by being made with deep ribs at the back, running both longitudinally and across, which impart the necessary quality.

One of the oldest forms of pump valve is the double-flap or butterfly valve shown in Figs. 1, 2, and 3. In Figs. 1 and 2, the valve seat is shown in section to exhibit the apertures through which the liquid passes when the valves are open as shown in Fig. 2, the liquid passing in the direction of the arrows; A A is the valve seat, having in it openings, E, E, shown dotted in the plan, Fig. 3; B, B are valves which work upon hinges, C, their movement being limited by the guard, D; the letters apply to the same parts in each figure; the valves are semi-circular in plan. Whenever the pressure below these valves exceeds that above them by the amount of weight of the valves, they will open, closing again as the pressure becomes equalised on each side. For small pumps with a light load of water, these valves serve well enough, and are, therefore, suitable to lift pumps worked by hand at slow speed; but, at a high velocity, the rapidity and violence of their closing would soon damage the seatings and render them leaky if made with metal seats and valves; the valves may, however, be lined with leather, provided the pressure of water is not great. In lifting pumps, the pressure will not exceed 15 lbs. per square inch in addition to that of the water above the valve in the pump bucket.

The weight of a cubic foot of water is almost exactly 62½ lbs., therefore the height of a column of water pressing upon a valve being known, the pressure per square foot upon it will be that height multiplied by 62½ lbs., and the pressure per square inch will be equal to the height in feet multiplied by 125 and divided by 288. The area of escape for the liquid around the edges of the valves will be equal to that of the openings, E, E, when the lift of the outer edge of the valve equals two-fifths of the diameter of the openings, E, E. As stated above, the valve will not open until the pressure of the fluid below exceeds that above it by an amount equal to the weight of the valve. In pumps for water and other liquids, this only requires consideration in the case of suction pumps, in which the weight of the column of water, in addition to that of the valve, must not exceed the pressure of the atmosphere; but for exhausting pumps—such, for instance, as the air pump of a steam engine, or the pumps for exhausting the vacuum pans of sugar refiners—more delicate arrangements must be adopted. If a vacuum is to be maintained, the valve must be of the least possible resistance consistent with its closing tightly enough to prevent a reflux of air, gas, or vapour, as the case may be. In Figs. 4 and 5 is shown a valve, the seat and suction passage being in section, in which the resistance to opening is determined by the angle of the valve seat to a vertical line. If the valve, B, depending from the hinge, C, were hung vertically, it would exercise no pressure upon the valve face, A, and as the inclination of A increases, so will the resistance of the valve, B; D is a guard to restrict the opening of the valve as shown in Fig. 5; E, E are flanges for attachment to the vessel to be exhausted.

The next example shown, shut at Fig. 6 and open at Fig. 7, is a spindle valve, having a conical seat; this valve requires to be ground into its seating to make a true fit. The seat, A A, is shown in section, F F being the part upon which the valve closes; B, the valve, carries a rod or spindle, C C, of which the lower end works through a hole in the centre of a wheel-shaped frame at the bottom of the inlet, between the spokes of which are the openings, E, E, to allow of the passage of liquid; the upper end of the spindle passes through a hole in the guide, D D, which also serves as a stop to restrict the rise of the valve, B; the height of rise necessary to afford an outlet equal to the inlet pipe is one quarter the diameter of the latter. These valves are simpler than the foregoing, inasmuch as the hinge is dispensed with; they have also the advantage that they do not require to open so widely in proportion to width as the previous ones, and will therefore close quicker and with less concussion. Rapid closing in valves has some special advantages which will subsequently be referred to in connection with a larger class of valve. A very compact form of valve similar in principle, but more self-contained than the last, is illustrated in Figs. 8, 9, and 10, the seats in the two former figures being shown in section. Fig. 10 is a plan view of the underside of the valve. This valve, which, on account of its compactness, has been much used for feed pumps, and others that are required to be stowed away in small spaces, is made with a stalk consisting of three wings or ribs cast on its underside; A A is the valve seat, which, besides having its conical part ground to fit the edge of the valve, B, is truly bored out to receive the wings, C, C, C, the edges of which are turned to fit it, and thus act as a guide to the valve. The rise of the valve in this case may be restricted by a set-screw, D, passing through the top of the valve box. The liquid escapes, when the valve is open, between the wings, C, as shown by the arrows in Fig. 9.

A simple kind of valve consisting of a ball, B, ground into a spherical seating in A A, at the top of the inlet, E, is shown in Fig. 11; it is kept in place by a guard, D. Where considerable area is required it has been proposed to agglomerate a number of these valves, but I do not know that such an arrangement has found favour. These valves must necessarily be disproportionately heavy in comparison with their areas; the balls also are somewhat costly, as they must be perfectly true to be of any use at all, and taken altogether they do not seem to possess any particular advantages to recommend them.

Passing from the comparatively small purposes for which the valves above described are appropriate to others of greater magnitude, such as the draining of mines and water supply of towns, we come upon essentially different forms of construction.

In order to make clear what is required of the valves under different circumstances, it is necessary to advert to the actions of the different kinds of pumps to which they are fitted, and this I will now briefly do. The simplest form is the common lift pump, with a flap or butterfly valve at the top of the suction pipe, and another in the pump-bucket itself. It occurs most frequently in agricultural districts where there is no town supply of water, though the principle has also formerly been used in connection with large draining schemes. Next is the lifting and forcing pump with a third valve at the outlet to prevent the water discharged under pressure from returning; but this is displaced by the plunger force pump, in which, instead of a packed bucket or piston to draw and force the water, a long plunger is used working through a water-tight stuffing-box in the top of the pump barrel.

Double-acting pumps have pistons worked by rods passing through stuffing-boxes in the pump covers, so that work is done simultaneously on both sides of the piston: drawing on one side and forcing on the other. For lifting and forcing large volumes of water the single-acting Cornish engine has been very extensively used, being one of the most economical in its action, and therefore generally adopted before the era of very high pressures commenced. In these machines a plunger pump is used, having on its rod a box loaded with weights, which in its descent forces the water out of the pump barrel; the pump plunger, together with its "preponderating weight," is lifted by steam pressure on one side of the piston, the other being open to the condenser. The exhaust is then shut and communication made between the spaces above and below the piston, thus equalising the pressure and leaving the pump load free to descend. The pump barrel is filled through the suction valve during the steam stroke. These pumps naturally work very smoothly; as there is no sudden change of motion, the plunger comes steadily to rest, allowing the barrel to fill completely before the down or forcing stroke is made, and if the pump valves act perfectly a full barrel of water is discharged at each stroke.

The valves for such pumps will necessarily be very large to allow the free passage of the water, and the old rule of making the suction pipe one half the diameter of the pump barrel soon became obsolete when the construction of large pumps came into the hands of thoughtful engineers, among whom Thomas Wicksteed stood pre-eminent as an improver of the Cornish engine. To give an idea of the mass of

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water dealt with, we may take a pump with a plunger 50 in. in diameter and working with a stroke of 11 ft., and such a size is by no means the largest in use. The area of a circle is equal to the radius multiplied by half the circumference, and the circumference is the diameter multiplied by $3\frac{1}{7}$; therefore the area of the plunger section will be 25 multiplied by 50 and by $3\frac{1}{7}$, and divided by 2 equals 1,964 square in., or, dividing by 144, equals $13\frac{5}{8}$ square ft.; multiplying this by the stroke of the plunger, 11 ft., we have 150 cubic feet of water expelled at each down stroke of the plunger, which, as 1 cubic foot contains $6\frac{1}{4}$ gallons, amounts to $937\frac{1}{2}$ gallons per stroke.

The friction of water in pipes varies as the square of its velocity, and the velocity of a given quantity of water passing through a pipe in a given time varies inversely as the square of the diameter of the pipe, therefore the friction of the water will vary inversely as the diameter of the pipe multiplied into itself three times—thus, if one pipe is half the diameter of another, the friction in the former will be sixteen times as great as in the latter; this shows the importance of making the valves and passages as large as possible.

Following the experience of smaller things, these large pumps were at first fitted up with butterfly valves, but their unsuitableness to such a purpose soon manifested itself. The great area of the valve met such resistance in shutting that instead of falling through the water it hung until the return stroke, and fell with the column of water. In such a case as that taken above, where the pump acted against a pressure of 100 feet of water, the weight thus falling would amount to $43\frac{1}{2}$ lbs. on every square inch of valve surface, and would cause a concussion at every stroke that would speedily prove destructive to the machinery. The first method tried to obviate this difficulty consisted in providing air-cocks to admit air under the valves so as to allow of their falling more rapidly by their own weight; but this was obviously introducing a gratuitous leak into the apparatus, and in some cases as much as sixteen per cent. of water was lost at each stroke, causing, of course, a corresponding waste in consumption of fuel. The real remedy was to be found in designing a valve that should close quickly from its own form without requiring any extraneous aid.

To get at the principle involved, let us consider the difference of retarding force of a plate falling flat and one falling edgewise. The force tending to buoy it up and retard its passage through the water arises from the friction of the water passing from the under to the upper side of the plate, and when that plate is flat it evidently takes the water a longer time to reach its margin than when it is placed on edge; there is in short a much greater lateral movement of the water necessary in the former than in the latter case. Suppose the plate to be an inch thick and a foot square, laid flat, when it has displaced its own bulk of water once it will have fallen one inch; if on edge when the plate has displaced its own bulk of water once it will have fallen twelve inches. The conclusion arrived at is, that while keeping a sufficient area of opening of the valve to allow of the free passage of the water, the area of the valve acting vertically must be reduced, and this is done by using the double beat valve shown in Figs. 12, 13, and 14. Fig. 12 is a vertical section of the valve closed, and Fig. 13 of the same when open. A A′ A′ A is a casting bearing two seats, of which the smaller is at the top, A′ A′; these are shown in plan at Fig. 14, where G G shows the lower and A′ A′ the upper seat. These are connected by ribs, F, F, etc.; through openings, E, E, between these ribs the water passes from the underside of the valve, B B, in the direction shown by the arrows. Part of the water passes under the lower edge of the valve, B B, and the remainder over the top seat and out through openings round the centre of the crown of the valve. C is a nut which limits the rise of the valve, the hub, D, coming in contact with it when the maximum rise allowed is reached. This valve affords a very large outlet for the passage of the water, for there is the full area of the bottom seat, and the resistance to the escape is also relieved by the outlet at the top; the pressure being thus rapidly reduced within the valve also aids in facilitating its fall directly the flow ceases. The difference of area of the upper and lower seats will be that opposed to the water, and on this the whole weight of the valve is taken; so this form will require a greater pressure to open than a flat valve, but that is of no moment in comparison with the advantages obtained by its use. These valves are made up to weights of 13 cwt., and sometimes more.

Under very heavy lifts the beat of these valves may be felt at some distance, and in some pumps which were used to force water to a height of 270 ft., I have employed valves of the form shown in Figs. 15 and 16; the letters refer to the same parts as in Figs. 12 and 13, the only difference being in the form given to the valve itself; the idea was to give the valve an elastic form, and also to provide better passages for the water to the upper seat, A′A′.

As soon as it appeared that something different from the old-fashioned valves was needed, numerous inventors arose and patented valves of all sorts. One which may be mentioned here consisted of a series of rings placed one upon another, and having a small disc valve on the top of all, the rings gradually diminishing in diameter upwards. The bottom ring formed a seat for the second, which formed a seat for the third, and so on to the top. This valve closed quicker than a plain disc valve of equal diameter would do, because, the water getting away between the rings did not take so long to get clear of them as to get from under a flat plate.

With the increasing use of high pressure, steam, and high speed engines, high speed pumps have also been introduced, the advantage being found in the employment of smaller and less expensive machinery to do a given quantity of work; therefore valves suitable to quick working pumps have become a necessity. In such pumps we have necessarily all kinds of concussions, for their action may be said to comprise a constant succession of sudden and violent reversals of motion; and if the engine is overrun actual blows will result, for there is a limit to the velocity for the suction end of the pump, which is that of the entering water. If this is exceeded the pump barrel does not fill, and on the return stroke the entering water is struck by the piston or plunger. In order to get the full advantage of the atmospheric pressure, it is desirable to place the pump below the level of the supply, for every foot of lift in the suction diminishes the speed at which the pump may be worked, while we can force out the water as quickly as the power at our disposal will allow.

With such machines it is evident that the natural fall of the valve will be too slow to meet the requirements of the case; the valves, therefore, must be shut by the returning current, the very action which in the large pumps proved fatal to the use of flap valves. In this case then we must design valves that will work in the way required without the resulting concussions becoming destructive. The chief points indicated as necessary are light and elastic material for the valves, large area of inlet and outlet for the water, and no working parts to shake or wear loose. The material that most nearly fulfils these conditions is indiarubber, but it has no strength to support the pressure of liquid over a considerable surface, therefore when used it is necessary to make the valve seat in the form of a grating, so that the indiarubber itself may be sustained against the pressure upon it. The less the lift of these valves the better it is, as the force of closing is proportionally less, therefore a large area, afforded by a considerable number of small valves, will be advantageous. The common form of circular indiarubber valve upon a grated seating is shown in vertical section in Figs. 17 and 18, shut in the former and open in the latter. A A is the seat and B B the valve, which is bolted between the seating and a cup-guard, D D, and secured by a nut, C; the guarding, D D, limits the rise of the valve and prevents its being torn or strained by any unusual pressure under it.

A form of valve in which indiarubber bands are used was designed many years since for use with a Cornish engine raising water to a height of 100 feet in one of the London waterworks. This valve, which gave perfect satisfaction, is shown at Fig. 19—the left-hand half is shown in elevation, the right in vertical section. This arrangement consists of a series of diminishing cylindrical seats, A A A′ A′, in the form of vertical gratings having apertures, c, c, etc., around which are wrapped indiarubber bands, B B, etc.; the water pressure within the valve distends these bands and so escapes around their edges, and the bands immediately contract upon their seats on the relaxation of the interior pressure.

Muddy and gritty water will invariably derange metal-faced valves, inasmuch as some deposit is sure to get upon the seating; to obviate the inconvenience thus caused, an indiarubber valve of the form shown in Figs. 20, 21, and 22 has frequently been used with success; it is, however, only applicable upon a small scale. It consists of a tube, A, which is shown at Fig. 20, in vertical section through the line, c c (Fig 22), on plan at which the lips meet. Fig. 21 shows a vertical section at right angles to the line, c c, at which the lips, B B, meet; these lips are forced apart by liquid passing through, and it is obvious that mud and other clogging material will pass freely through, there being no valve seats on which to deposit. These valves are not suitable for high lifts on account of the yielding nature of the material of which they are composed. The idea appears to be taken from the form of certain valves occurring in the circulatory system of animals.

In the preceding remarks I have sought to put before my readers a description of the various kinds of valves in use in pumps, and to show, I trust clearly, their construction and advantages or disadvantages, as the case may be. I shall be happy to give further information through "Shop" on any point which may seem to require further elucidation.

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IRON SOIL-PIPES.

BY W. R.

THE rage for speculation which has taken possession of the business men of this age has made itself as evident in the building trade as in any other, and to the driving of hard bargains and close-fistedness of property buyers, can often be traced the reason for the fixing of sun-dried bricks, trashy joists, and, worse than all, defective sanitary arrangements.

Especially is this noticeable in the drainage and sanitary plumbing of modern middle-class houses.

In these, lead as a material for soil-pipes is never used. Cast iron, often badly fitted, has been made to take its place.

Now, every intelligent plumber knows the advantages which lead possesses over iron when used for this purpose. Its resistance to corrosion (when well ventilated), the smoothness of the interior (when drawn, not seamed), its adaptability to jointing—all go to proclaim its superiority over iron.

But yet these builders must use iron, for the simple reason that the people for whom they build will not pay the price for lead. Such being the case, it remains only for the plumber to make the best job possible of the materials to hand.

The two worst faults of iron pipe are its liability to corrosion and internal roughness; these may successfully be overcome as follows:—

Get each length of pipe to nearly a red-heat; this may be done by standing it upright on the plumber's fire-devil or grate in the open air, and lighting a blazing wood fire under it. The pipe should be turned end for end once or twice to make it uniformly hot. When nicely hot, coat it inside and out by means of a long handle tar brush, with a mixture of pitch, tar, and resin in the following proportions:—Pitch, 7 lbs.; coal tar, ½ gal.; resin, 2 lbs.

These ingredients should be melted in an iron pot, the pitch and resin first, adding the tar afterwards when the pot is off the fire. When the pipes are quite cold, they will possess a glaze impenetrable alike to water or sewer gas.

The next thing is the fixing. The pipes should be fastened to the wall as usual by hooks and clout nails through the ears, but every length should have a small wood block placed behind the ears so as to set it off from the wall about an inch (the nails passing through it will hold it in its place), for the purpose of getting the hand round the pipe in jointing. The first length should be placed in the socket of the earthenware bend or junction which has been brought to the surface to receive it. This joint should be made with cement, first, however, placing a ring of tow or flax inside the socket to prevent the cement from running through into the pipe, and thus causing an obstruction.

Before inserting the next length, and, in fact, all above, paint the lower socket with a mixture of red lead and linseed oil.

Paint the end of the pipe to be fixed with the same; now wrap round this end some nice soft tow or flax, and well saturate it with the red lead paint. Put the pipe in its place, and fasten it there. Next caulk in with a thin tool as much tow as you can, occasionally brushing in the paint until the socket is nearly full. Be careful in caulking; do not use a hammer, the tool itself will be quite sufficient, for the ordinary cast-iron pipe will not stand many heavy blows.

Now mix up some red and white lead to the consistency of dough and fill up the socket with it, well squeezing it in to fill up all crevices, and the joint is finished. Joints made in this manner have stood the smoke test many years after being fixed, without the slightest leak or crack being found in them.

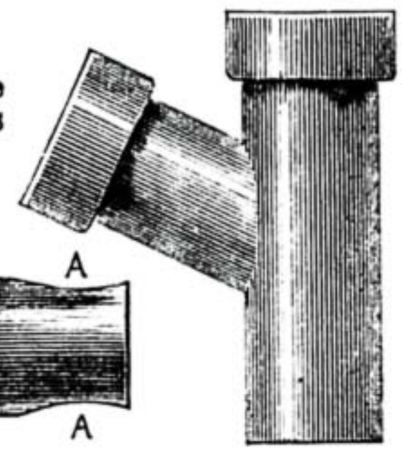

Fig. 1.—Branch Pipe usually known as a "Y-Piece."

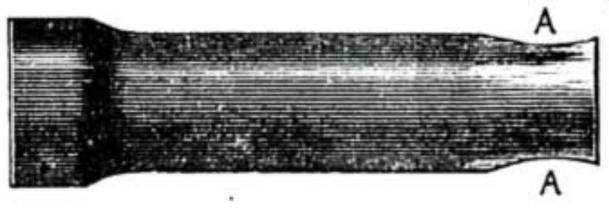

Fig. 2.—Piece of Drawn Lead Soil-Pipe—A A, End compressed to enter Socket.

Now as to the connection for the water-closet, which usually in these modern middle-class houses is either a "wash-out" or "wash-down" pattern. These earthenware closets, by-the-bye, are, generally speaking, the best sort for use in those positions where we often find a large family using one place continually.

Before the soil-pipe is fixed, a hole should be got through the wall on a level with the floor-line of the water-closet for a branch to pass through.

Fig. 3.—Mode of connecting Pipe with Canvas, String, and Red Lead.

The trap should then be placed in the exact position it is intended to occupy, and temporarily fastened there.

When the stack of iron pipe has nearly reached the hole in the wall, the branch piece should be put in its position in regard to the closet trap (which, in this case, would be P shape), and the length of the iron pipe taken, which is necessary to connect it with the other pipe below.

This branch, or, as some call it, "Y-piece," is shown at Fig. 1.

Almost any size can be obtained, but 4-in. is generally used for this class of work. Of course, this fitting should be coated the same as the rest.

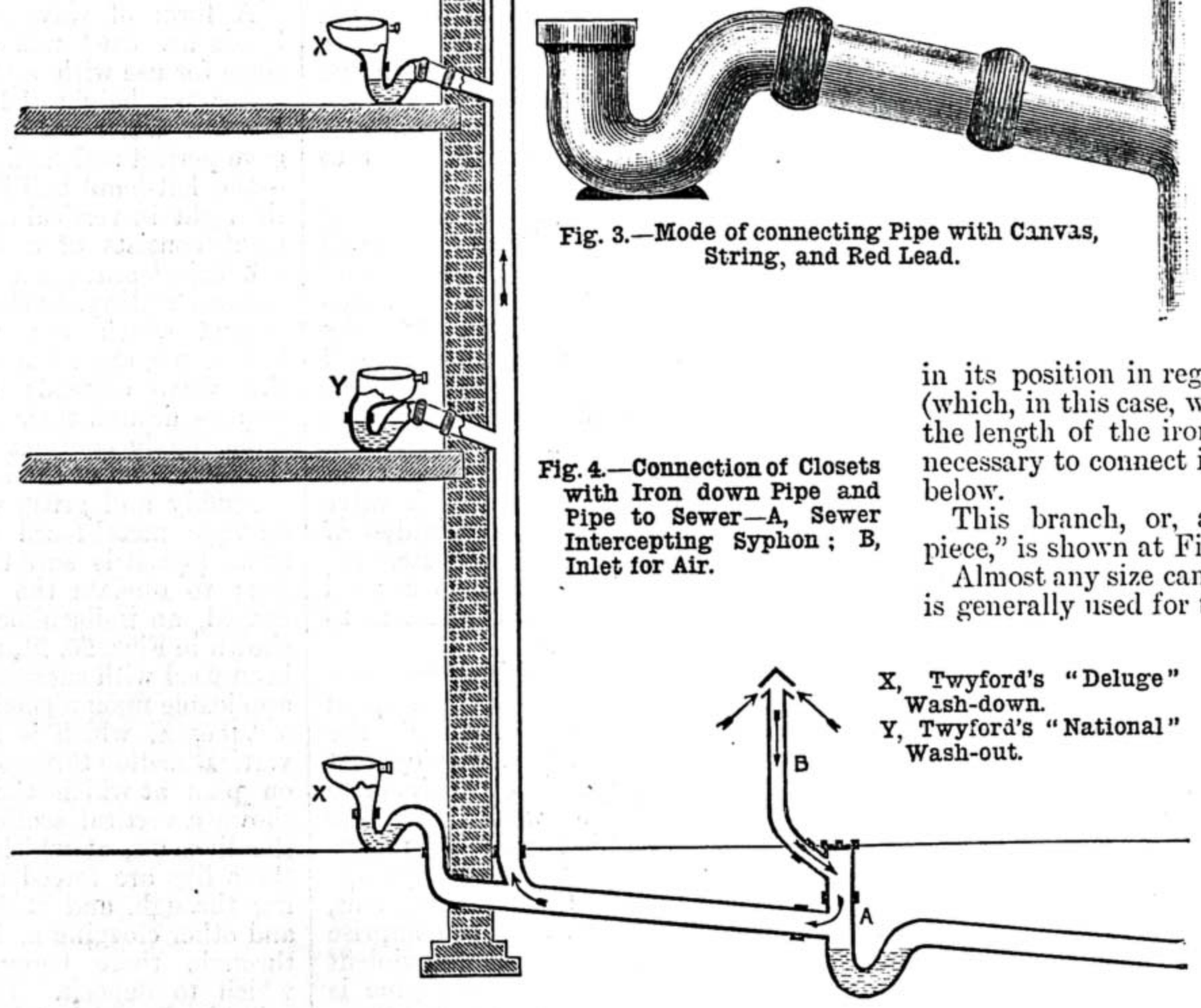

Fig. 4.—Connection of Closets with Iron down Pipe and Pipe to Sewer—A, Sewer Intercepting Syphon; B, Inlet for Air.

X, Twyford's "Deluge" Wash-down.
Y, Twyford's "National" Wash-out.

The lengths of pipe should then be continued to the next water-closet if there be one, and then on again above the roof for the purpose of ventilation, as shown at Fig. 4.

We shall find our branch pipe has barely passed through the wall to the water-closet, and is from one to two feet away from the outlet of the trap.

These must be connected up by means of a piece of drawn lead soil-pipe (not seamed, mind) opened at one end to receive the trap, and drawn in at the other to enter the iron socket of the branch piece, as shown at Fig. 2.

It will be seen that the smaller end of this connecting piece is opened out a little. This should fit in the iron socket tightly, leaving a space, A A, to hold the packing. Take

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care that the end of this pipe goes right into the end of the socket, so as not to leave any space for the accumulation of filth.

This connector should now be fixed, the joints being made with the same materials as the others, but they should not be caulked, as that would cause damage both to the trap and lead pipe. Instead of this, when both sockets are full, place a thick layer of the mixed red and white lead round each, and take strips of canvas or calico, and make a bandage round them.

Saturate the whole with red lead paint, and then bind on a regular layer of stout string or cord as shown at Fig. 3. This binding will prevent any falling away or cracking of the packing, and in a very short time the whole will set so hard as only to be parted with the greatest difficulty.

In making the drain, a sewer intercepting syphon should have been fixed, as shown at A, Fig. 4, with an inlet for air, B, which should be a pipe about 5 or 6 ft. high, fixed to the nearest wall for support.

There is one thing which cannot be too strongly insisted upon :—*Never carry a soil-pipe up inside a house.*

If these precautions be taken, the cost for workmanship will be but slightly increased, while the causes for complaint against cast-iron pipe will be completely removed.

THE AMERICAN LEVER WATCH.

BY A PRACTICAL HAND.

WALTHAM, ELGIN, OR BOSTON LEVER.

THE Waltham lever in my opinion is next best in quality and equal in timekeeping to the well-finished English lever. Some will differ from me, I have no doubt, but this was settled a few years ago, after a long discussion in the English press, and was decided in favour of the hand-made English lever on account of its durability.

The Elgin watch, taking its cost and appearance into consideration, is a very strong and useful watch for the working man, far superior to its imitator the common Boston, with its half-finished wheels, the underside of each being left in the rough. Of course the public do not see this, and top plates, etc., are scarcely gilded at all; the few paltry so-called jewels are only on the plate in sight, the under plate is minus. They go fairly well for a time, but the best plan after that is to quit them, or they will be a never-ending source of annoyance and cost. The cases are the lowest mixture of silver, which will scarcely keep bright with wearing; when made in so-called aluminium it is simply brass badly plated. The wearer finds that out in the course of a few weeks. The same price paid for a Swiss silver lever would be money wisely spent. Of course some one must buy them, but my advice is the same as *Punch's* advice on marriage—"Don't."

To clean the above style of watch first take off the hands, hour and minute, with one lift, then carefully raise the seconds hand *evenly* with tweezers so as not to injure the pivot point on which it is fitted; open the inner dome and turn the half-headed screw so as to free the works from the cases; press them out face side. Now hold the movement in your left hand, and draw out the three pins holding the dial in its place; take off the dial and the three dial wheels, as described in page 406; turn over and unscrew the cock or cover to balance and mark the end of hairspring; draw out the pin which holds it in position, and remember which way out, so that in replacing it you do the same; if not you will wonder why it will not go when complete. Lift out the balance and place under glass cover for safety, then let down the spring by turning the winding part a little back, and slip out the click from ratchet notch, gently allowing it to turn down.

Having done this you may now proceed to unscrew the top plate by the three screws

Fig. 1.—American Lever with Top Plate on.

holding it in position, and after examining it well, so that you can remember the position of each part, the top plate ought to be very gently lifted so as not to break or cast any pivot point or other injury; notice the lever, and take out so that you may not drop it and lose it. And so take out each wheel.

One thing in these watches is the ease with which you manipulate the spring barrel; as there is no chain or fusee wheel, in this point they are superior to our watches. There being no chain or fusee work the motion is direct from the spring wheel, for the teeth are around the rim of the barrel. The English makers claim, which of course is true, that by the fusee arrangement the pressure is more equal all the time; the greater leverage when spring is nearly uncoiled. Any one will see that; whereas the American watch must have a longer and exceedingly well-tempered spring to give anything near equal leverage. You will notice, if you listen, that the beat is much weaker when nearly run down.

To proceed, polish the wheels with the brush drawn over the prepared chalk, and also clean plates, using a rotatory motion so as not to show scratches. Many recommend

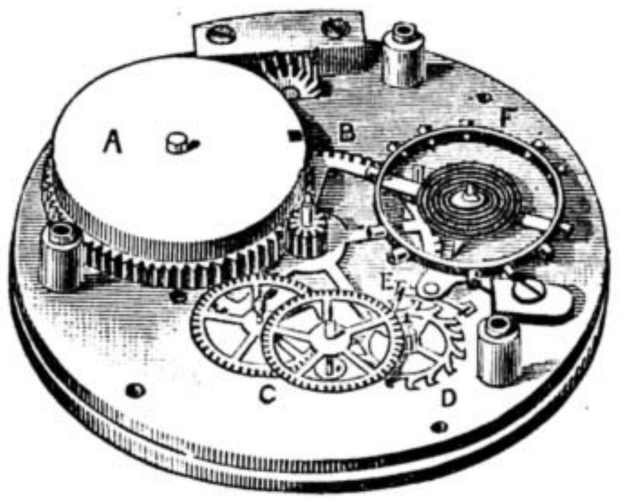

Fig. 2.—American Lever Waltham with Top Plate Removed– A, Barrel; B, Centre Wheel; C, Third and Fourth Wheels; D, Escape Wheel; E, Lever; F, Compensation Balance.

using benzine to dip them in, but unless of the very purest quality the work is unsatisfactory.

Note that it is not advisable to take out the mainspring, for three-fourths of the trade do not, so why recommend it to the amateur; but if you are really of opinion that it must be done to make a thorough job, prise off the lid of spring barrel. Notice the small dots so as to be right when putting it on again; now undo the end of spring in the middle and lift it gradually out, holding the remainder in by your thumb nail, and so gently turning and allowing it to leave; if not, why it will snap off the end at its stud hole. Clean the spring with an oily rag, and brush out the box free from grit; now hook on the spring and gradually work it in as you worked it out. Of course we in the trade do it in a different way, but I am writing for those with few tools, and to describe how would be no use.

When all the spring is in the barrel, put in the centre and hook it on, and try by turning it if it has proper hold, so that when boxed up you may have no further trouble; if it does not grip it, just lift centre out and gently squeeze it inwards. Now replace and try again. Put on cover as previously stated and turn with the key to see if all right; if so, place under cover; having pegged out all the holes clean, touch each one with the oiler, and if you are certain none are worn oval or any jewel broken, cracked, or injured, by such carefulness you may save much time and annoyance.

Having got thus far you may proceed to put together by placing the centre wheel and next the spring-barrel wheel, which works into it and each one; now place on the top plate and guide each pivot into its place; press down, and try if the train runs easy by gentle pressure upon the main-spring wheel; if so, all is right so far; gently raise up the top plate and insert lever pallets with tweezers, using your eye glass. This is not such an easy job to do, but patience will do it, and when all pivots are again in place, also pallet part, then try pressure; and if the pallet moves quickly you may proceed to screw down the top plate; if not, some part is too tight; gently ease the top plate, and try again and screw down. Place on outer plate, holding barrel in position, and screw down with two smaller screws; then as stated before how to clean balance and its spring, replace it, and pin into same mark on the plate; run the pin in *right side*, drop the last coil in betwixt the two studs of regulator, and drop on the cock or cover. Try it to see that pivot is in the jewel hole; if so, screw gently down, trying it all the time by shaking movement, or you may finish the pivot. Try if lever works by using pressure; if not, and balance is locked, or what we call overturned, undo cover, gently raise balance, and just push the extreme outer end of lever towards the other pin and drop balance in again; screw down, and you will find it all right. Now wind up, and the watch will once more be in order; but if the beat is unequal you have not pinned the hairspring to its proper place; partly push out the pin and draw spring a little and try again; if worse, draw the other way until the beat is satisfactory and the pin tight. We have another way to put in beat, but I write so that any may understand; if not, my time and yours is wasted.

Now try the watch for a few hours, and if still working with goodwill replace the dial wheels and dial as previously stated (page 406), and fit into cases; turn the half-headed screw, and replace hands all in correct manner, so that each minute is complete, as the seconds hand denotes. Close cases, and the job is complete and satisfactory no doubt, and in many cases equal to that done by a village watchmaker, so called.

In my next paper I will tell you how to clean the English lever.

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BAMBOO WORK AND MATERIAL.

BY DAVID DENNING.

THE trade in bamboo furniture, both useful and ornamental, has of late years made such rapid strides in this country, that no apology need be offered for introducing the subject in these pages with the view of still further popularising it, not merely when made up, but for the workers, either amateur or professional, who may have a taste that way.

For some reason or other, bamboo construction has not received that amount of attention which one would imagine it would have attracted. We are all familiar enough with the appearance of things made partially or wholly of bamboo, but comparatively few are aware of the immense scope this branch of art work affords, and the ease with which the mechanical details can be learned.

Without, at the present time, giving directions for the construction of any specific piece of furniture, a few general remarks will no doubt be of assistance, and perhaps induce many to profit by the designs which will, from time to time, be offered in these pages. In fact, we may consider the subject of bamboo work as virgin ground, which must be surveyed and gone over, ere the practical planting and completion of diagrams can be proceeded with. We may look on the present article as a preliminary canter into an almost unexplored region, of which only some of the salient features can be noted.

We are, perhaps, at first struck by the apparent flimsiness of things made from bamboo; they look so light and fragile that it almost seems as if they could be blown apart.

Further acquaintance, however, shows us that they are by no means so fragile as they appear. The bamboo itself is strong and tough, so that the only source of weakness can be at the joints. That many of the things made of bamboo are not so strong at these parts as they should be, is not to be denied, but with due attention when designing anything for construction in bamboo, *i.e.*, remembering the nature of the raw material and acting accordingly, there is no reason why there should be any inherent weakness in any portion of the work. If any joint or constructive detail is so weak as to render the piece of furniture, be it bracket, table, or whatnot, useless for the purpose which its shape shows it to have been intended for, bad design or workmanship must be blamed, not the material used. It is no use making a pretty thing only, that is to say, unless it is for pure ornament. However pretty to look at, let us say, a chair might be, it is obvious to every well-trained mind that, unless it fulfils the object of chair, the mere prettiness repels rather than attracts. One may admire the design as a design in the abstract, but the futility of the chair causes the beholder to have a feeling akin to pity for those who can admire it. This, of course, is merely an adaptation of the principle that truth is essential to beauty. First truth, then ornament, and if this be remembered, the first great law of art is appreciated. False construction and beauty cannot go together. Now, to the art student, these remarks may seem quite unnecessary, as the principles of them have been inculcated times without number. They are, however, of such extreme importance to the bamboo worker, that insistence on them can hardly be too strong. The worker, to whom they have become almost second nature, is not likely to ignore them, but there are many who seem to think that the highest art is not to hide art, but by artifice to make some material resemble something else. No matter where we look, we find this feeling proclaiming itself in all its hideous vulgarity. "Look at me," says the result of misapplied talent; "you thought I was made of wood—I look like it; but, ha, ha, I have taken you in—I have deceived you. I, through the perverted skill of the artificer who made me, am false from beginning to end; I am in reality made of iron." Well, perhaps exclaims the reader, is not iron as good, as sound, as strong, and useful as wood? Yes, every whit, and, perhaps, better for the purpose of the speech-endowed article above. The material is right, but the wrongfulness consists in trying to make it resemble something else. We may admire, or, let it be said rather, wonder at the dexterity of the artificer, but the feeling is one of pity that he should have gone so out of his way to create a deception. The material and its capabilities must be kept in mind when designing anything.

Now, in bamboo, it is necessary to always remember that it has qualities peculiar to itself. We cannot treat it as if it were so many pieces of wood such as is used in ordinary joinery or cabinet work; it must be manipulated as bamboo not as wood. It cannot be reduced in diameter, but we can select pieces of such a thickness as may seem appropriate. The main portions must be thick comparatively, thick and strong enough to be serviceable, the decorative details being of the smaller and lighter pieces. These can be bent with ease, so that the straight, stiff lines of the main construction are relieved by variety. Then, again, a judicious arrangement of colours afford further scope for the display of taste. However, as the artistic principles involved in bamboo work are not confined to it alone, let us, instead of dilating on them, further descend, or, if the worker who thinks "art all bosh" prefers, ascend to practical work.

"Ah, that's right; he's going ahead now," I almost fancy I hear some one say; or is it the cricket chirping which suggests the words, "and leaving his 'igh hart" notions? Well, my friend, if I have not mistaken the cricket's utterances for your own, let me, in the first place, say that I have no sympathy with "high art" for its own sake; and secondly, without art, no worker can be a master of his craft. I have written a little "art," but I trust not "high art," which, at its worst, is an incomprehensible mystery, even if it is not, as you suggest, "all bosh." If I have unfortunately written anything that is not to be understood, then I plead guilty to having encroached on high art, and freely forgive you for having mistaken what is intended as art, for what is erroneously spoken of sometimes as "'igh hart."

Art and craft must go hand in hand, if our present-day manufactures are to be of any more than merely temporary value, and the more closely the worker can connect the two the better, even in what may possibly be only a passing fashion, such as bamboo furniture.

Well, let us leave the lecture-room, and get right into the workshop. What is the raw material to be? What tools are to be used? These are among the first questions which will occur to the novice's mind. Let them be answered in a general way. You do not want to know about the botanical history of the bamboo, so though a string of scientific, and, perhaps, very interesting, particulars might be given, they must wait. What we have to do is to speak of bamboo as we find it ready for working up.

Roughly speaking, the kinds may be specified as black, brown, yellow, mottled, mahogany, and spotted, according to colour and marking. All the colours are merely approximate, as different sticks, or to speak technically, canes, in a bundle vary considerably. The artificially coloured canes, such as black and mahogany, of course are more uniform than those which are left in their natural state, if we except, perhaps, the yellow variety. In addition to the plain stained canes, there are some such as the tortoise-shell with fancy mottling produced by artificial means. All the kinds are obtainable, either with or without roots, the rooted canes being the dearer of the two. It must not, however, be forgotten that occasionally dealers run out of sorts, so that the purchaser must not make too sure of getting just what he wants at a moment's notice. The sizes of the canes vary considerably, the thickness being from $\frac{1}{8}$ in. to 3 in. or more, those most useful for furniture of the fancy kind being from $\frac{1}{2}$ in. or $\frac{3}{4}$ in. to 2 in. In length, they are from 3½ ft., the thinner canes up to say $\frac{3}{8}$ in. thick not exceeding this, while the thicker ones are cut in 6 ft. and 13 ft. lengths. Other sizes are also to be met with, but those named are about the most common. One variety of small canes known as Tonkings should not be omitted. Ordinary canes or rattans are also used, and come in handy for a variety of articles.

The prices fluctuate a good deal, and it is impossible, if not out of place, to give them in detail; but the following extracts from a recent quotation by one of the principal, if not the chief importer of bamboos, etc., may be of service:—

Feet					in.		in.	dia.	each.
6½	black	bamboos	without	roots	¾ to	1	„		4½d.
„	„	„	„	„	1 „	1¼	„		7½d.
„	„	„	„	„	1¼ „	1½	„		8d.
„	„	„	„	„	1½ „	1¾	„		9d.
„	„	„	„	„	1¾ „	1¾	„		10d.
„	„	„	„	„	2 „	2¼	„		11d.
„	„	„	„	„	2¼ „	2¾	„		12½d.
„	„	„	with	„	¾ „	1⅛	„		7½d.

Tonkings from 20s. per 1,000 according to size.

It should be noted that the above are retail prices at which the dealer referred to is willing to sell small lots, and that in wholesale quantities the figures are correspondingly less. As some guide to what constitutes a wholesale order it may be said that a bale containing 100 canes of a sort is the smallest quantity, and that any fewer, or even that number made up of several sorts, can only be supplied at retail prices. In case it may be thought that this is irrelevant, let me say that these particulars are inserted as owing to the mention of his name in a contemporary, the dealer who quotes the above figures is pestered by numerous letters from persons asking his *wholesale* prices and favouring (?) him after a prolonged correspondence with an order for half a dozen canes.

It will be a great pity if readers of WORK are so indiscreet as to alienate the good-will of large dealers, not only in bamboos, but other commodities, by what one can only stigmatise as "sharp practice." If I may make a suggestion to the fraternity who are always seeking to get bargains and buy under value, it is that they should remember that time is of some value to men of business and to those who have something to do, and that by worrying large dealers or manufacturers who may be willing to oblige the readers of WORK by

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supplying small quantities, they are likely to do a serious injury to the professional artisan. or even to the amateur, whose proceedings are more business-like and straightforward.

In many of the larger centres of population there are manufacturers of bamboo work who would probably be willing to supply amateurs with such small quantities of the raw material as they are likely to require, but London is the chief market for it. To name any dealers here would be invidious, especially as firms supplying bamboo have already been mentioned in the shop columns.

The tools required for bamboo work are few and simple. A saw of some kind, preferably a small one, is necessary for cutting the canes into lengths. Half-round files of various sizes are also useful, if not indispensable, for shaping the ends to fit against surfaces. This may, however, be managed with a knife alone. Indeed, with patience and a knife almost any piece of bamboo furniture may be constructed, though it goes without saying that the few tools suggested greatly facilitate operations. Several bits for boring are also advisable, though in their absence holes can be made, or rather started, with a gimlet or other suitable tool, and then be enlarged to the required size with the pointed end of a knife. When it is said that unless a thin piece of bamboo is let into a hole bored in another, the usual mode of fastening is by means of wooden pegs or dowels, it will be seen that some contrivance by which these may be cut will be required. The dowels are fitted into the canes, which it may be assumed every one knows are hollow and then let into holes bored partly through the other piece. If this rough outline of the construction is not sufficiently clear to enable novices to start bamboo working, it may be said that in succeeding articles the subject will be more fully gone into, and as illustrations will be given, every necessary detail will be made "as clear as daylight." Glue and nails, it is almost superfluous to add, are required, and having said this, no further remarks are necessary about the appliances used, as those who are familiar with joiners' or cabinet makers' tools will be able to evolve from their inner consciousness the easiest methods of working, while those who are not will soon devise means and become proficient.

One great advantage for the amateur, and perhaps I should say for the professional, worker in bamboo is that there is very little waste of material. The short pieces and odds and ends can be used up till it is hardly too much to say that not a scrap will be left over.

In due course various small articles which can be made up from "waste" will be suggested, so in the meantime the worker who may not have many ideas of his own in this direction may as well keep the bits which at present may seem useless to him.

Bent bamboos have been referred to, and the most casual observer cannot have failed to notice that in many articles made from bamboo the canes are curved. For example, in a table the feet are splayed, not only for the sake of appearance, but to give stability. Now though it might be possible to bend bamboos by hand only, in many positions where the construction is such that the curves are kept from springing out again, the novice will soon find himself in a difficulty in such a case as instanced, viz., in a table leg or foot. The bamboo must not only be bent, but the curve must be retained. The bending may easily be managed by the aid of heat, either dry as from a lamp or by steam. Naturally the former is the easier of the two, and is used by the chief bamboo workers. The bamboo is warmed at the part to be bent by holding it in or over a smokeless flame, in which it is moved about to avoid burning. The cane soon becomes plastic enough to be bent with the utmost facility, and when cold the curve will remain unalterable. A spirit lamp gives an excellent flame for the purpose, but almost any source of heat will do, provided care be taken that the surface of the cane does not get smoked. The heating should be gradual, and on no account must the bamboo be allowed to remain motionless, that is, the flame must not play on any one part sufficiently long to burn the cane. Of course the heat must be applied all over the surface to be bent, and gentle force be used till the desired curve is attained.

Bamboo cannot well be painted, but where nice finish is required it is often gone over with a rubber of polish or glaze.

With these few general remarks by way of introduction to the useful and artistic manipulation of bamboo, the present hints must be brought to a close, and, as it has been said, diagrams and designs accompanied by descriptive explanations will be given in future papers for the benefit of those who, either by way of recreation or from trade considerations, wish to have some acquaintance with the manufacture of bamboo articles.

ENGRAVING ON METAL.

BY NORMAN MACLEAN.

Introduction.

I HOPE I shall not discourage our many readers, male and female, if I mention in the course of this paper a few of the difficulties of this delightful art, followed either as a means of subsistence or as an agreeable occupation for leisure hours.

The practice of engraving is comparatively clean and inexpensive, and its elementary principles are easily learned. By this, I mean that an ordinarily diligent pupil will make such progress as to give him, or her, encouragement to greater efforts. Although I have not come across a workman who of my own knowledge has been self-taught, I have known instances of individuals who have picked up the trade, aided by the assistance of some good-natured workman, and by assiduous practice have so far become good engravers as to have ultimately earned their living by the profession; not perhaps in the highest style of art, but good enough for some mercantile purposes.

The first thing to be considered is the capability for drawing in the learner, who should be able to handle the pencil with ease, as, in the first instance, the subject has to be drawn before it can be cut with the graver. A few terms at the nearest School of Art will be of great use to the young workman, as a knowledge of the principles of drawing will enable the engraver to correct a bad sketch, and also to trace patterns quickly, which in these days of keen competition is an important consideration.

We now come to the requisites for the practice of engraving. A good, strong bench (Fig. 17) sufficiently high to stand at while working at large work—such as a tray, dish cover, or brass name-plate—a good light, and a high stool to be able to sit comfortably when engaged on smaller work, with a box to rest the feet upon when sitting, or when standing on the box, to increase one's height when using the block (Fig. 18) for large hollow ware. This block is fixed, when required, in the hole shown near the edge of the bench, and secured by the wooden nut shown above the block. The block is turned out of beech or elm, and has a slight hollow turned in the top, in which to place a sandbag, and on which the *inside* of the dish cover rests. The engraver, by this means, gets a firm hold of the cover, is enabled to turn it in any direction, and to avoid scratching or bending the side opposite to which he is working.

But for ordinary work which may be done at home the workman may utilise a table, taking care that it stands steadily without rocking, and use an ordinary house chair.

For tools, a very few will suffice at first, but it may be as well to procure all tools likely to be required, as it is a business maxim that "to wait for necessary tools is time doubly lost." Herewith is a list of the tools required by an engraver, with their approximate cost, followed by a list of firms who deal in such tools:—

Engraver's Outfit.

	s.	d.
1 Sandbag or cushion on which to rest the work	2	0
1 Sandbag or cushion, smaller size	1	4
1 ,, ,, smallest size		10
1 best Arkansas oilstone (any price over)	6	0
1 dozen Stubbs's square gravers (prices vary), say	2	6
1 dozen graver handles (prices vary), say	2	0
1 tracing or etching point (steel, with ebony handle)	1	0
1 Oil can		6
1 Burnisher (steel, with curved end, handled)	1	3
1 Scraper	1	3
½ dozen shading gravers, D threads (handled) Numbers 2, 4, 6, 8, 10, and 12 widths, at 1s. 3d.	7	6
½ dozen plain flat gravers of the above widths, at 3d.	1	6
1 pair Stubbs's spring dividers, say	2	0
Cement block, cement, oil, turpentine, pencil, indiarubber, and pounce bag, say	1	6
Practice plate (German silver, buffed or polished ready for work, about 1 lb.), say	2	6
	£1	13 8

Brass and Zinc Engraver's Outfit.

	s.	d.
1 Diesinker's chisel for outlining, say		8
1 ,, ,, for sinking the letters, etc.		8
1 ,, ,, wider than above		8
1 pair 12-in. compasses (steel points)	3	0
1 pair large spring dividers	3	0
1 T-square, straightedge, and rule combined, say	2	6
1 Sandbag, 12 in. in diameter when filled, say	4	0
1 Hammer (handled), say	2	6
1 small flagstone, 14 in. by 14 in. by 2 in.		
6 lbs. of cement, at 3d.	1	6
Zinc plate for practice, 3½d. per lb.		
Pumice-stone, water of Ayr stone, crocus, and lampblack for polishing, say	1	0
Archimedean drill and bits	3	6
Files	1	6
Bench vice	7	6
	£1	12 0

Manufacturers and Dealers in Tools, etc., for Engravers.

J. Sellers & Sons, Arundel Street, Sheffield.—All tools. Manufacturers and dealers.

Peter Stubbs & Co., Manufacturers, Lancashire—Lancashire tools and gravers.

J. Townley & Sons, Bull Street, Birmingham.—Tool dealers.

T. W. Woods, 60, Alderson Road, Highfield, Sheffield.—Threaded shading gravers only.

Starr & Son, Button Lane, Sheffield, Leather Merchants.—Engravers' Sandbags.

Tubbs & Wilkins, Great Hampton Street, Birmingham.—Engravers' cement.

Tucker & Sons, York Street, Sheffield.—German silver, brass, and zinc plates.

Buck & Son, Holborn Viaduct, London, E.C.—All tools.

The above tools are all of the very best quality, and are of the same make as those I use myself, and will cut anything between

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Britannia metal and moderately hard steel. If the expense of the above outfit is too great, a smaller quantity may be got at first, the purchaser using his or her judgment as to what may be best dispensed with. The workman now being supplied with tools for a start, I will first deal with the oilstone, as being the most important; as without a good one the engraver cannot whet his gravers in a proper manner. In choosing an Arkansas stone, endeavour to see the *of the mallet* will fix it. A new stone will not cut very readily, and to make it "bite" scrub it well on the face with a piece of gas-coke and plenty of oil, which will remove a gummy substance often formed on stones when they have been long in stock. The new stone will soak up a large quantity of oil on first being used. Do not forget to clean the stone occasionally, paraffin oil being an excellent cleanser. A useful form of oil can is shown in Fig. 6.

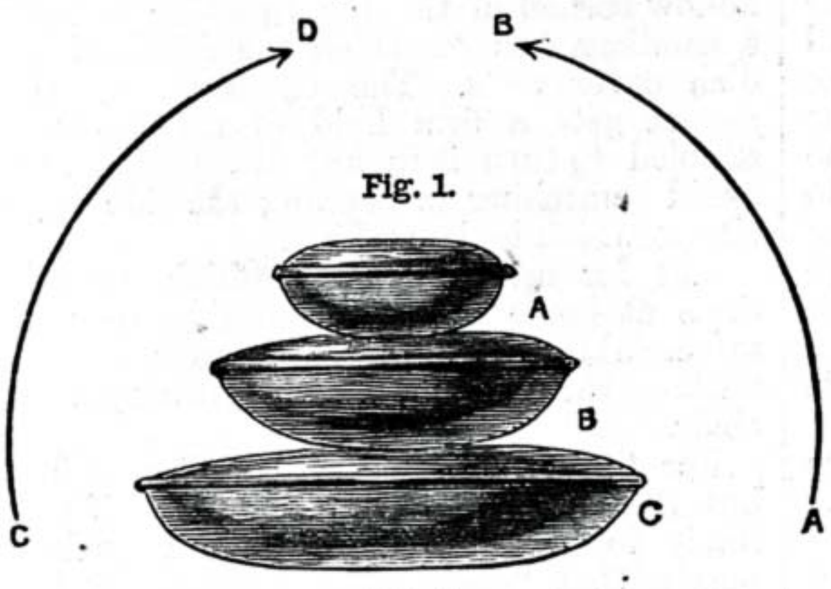

Fig. 1.

Fig. 2.

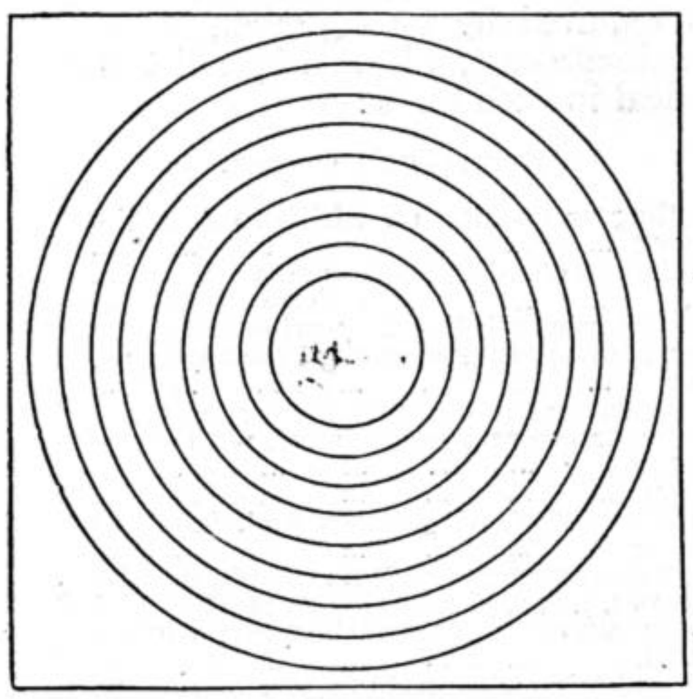

Fig. 9.

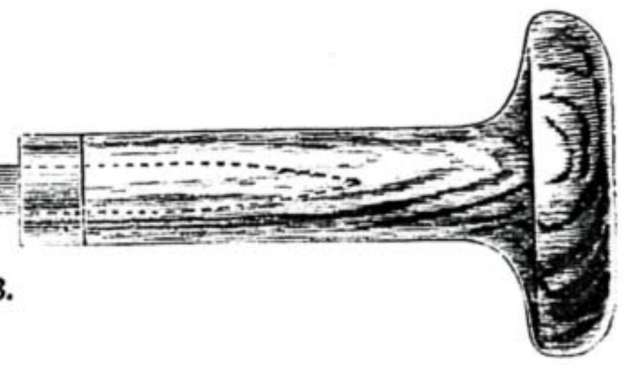

Fig. 3.

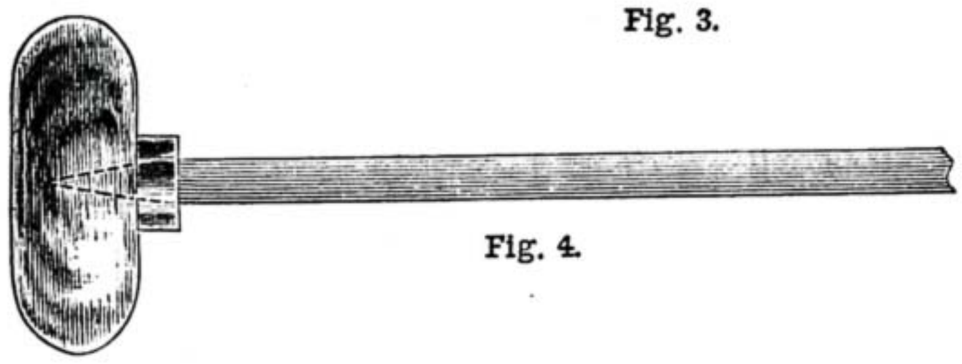

Fig. 4.

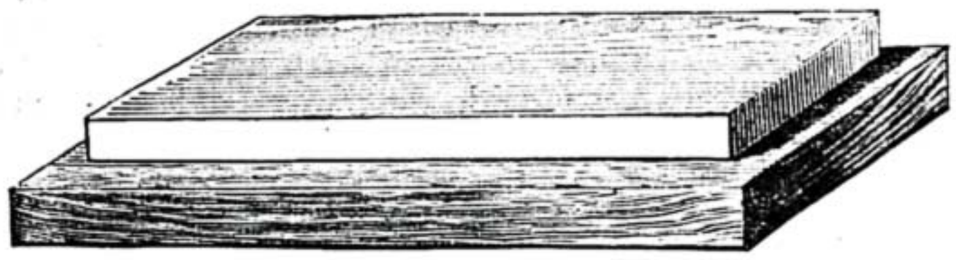

Fig. 5.

Fig. 6.

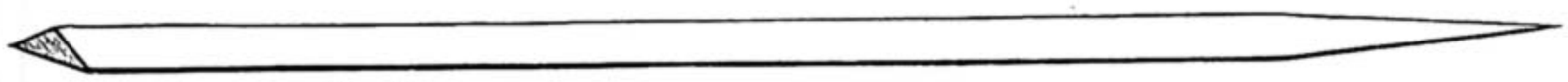

Fig. 7.

Fig. 8.

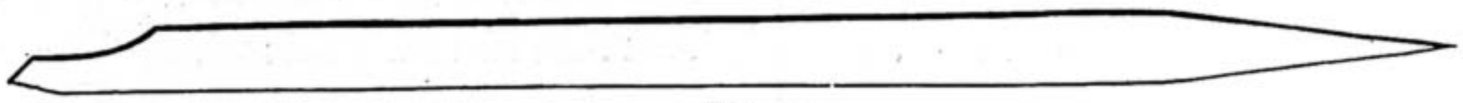

Fig. 10.

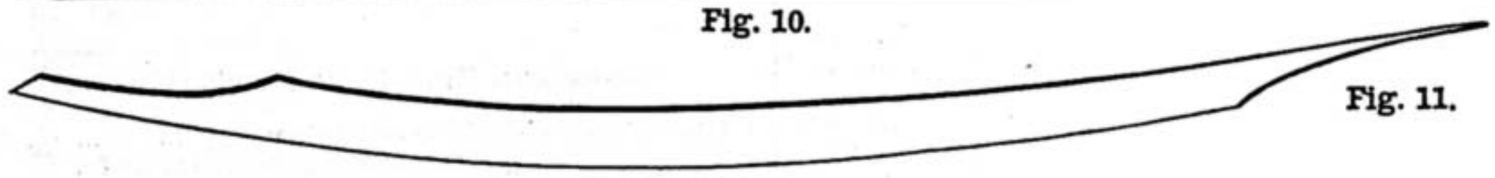

Fig. 11.

Fig. 12.

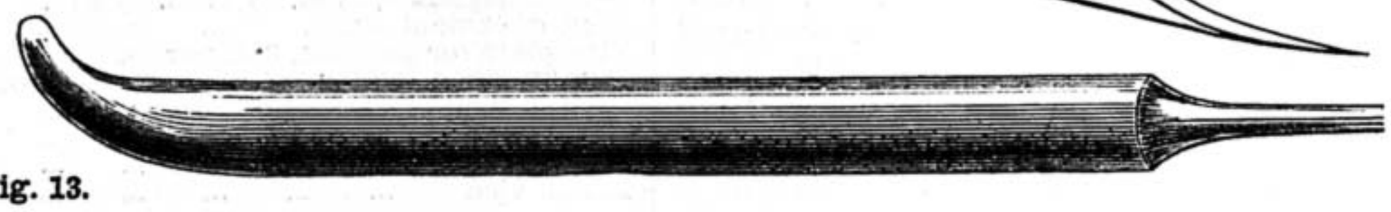

Fig. 13.

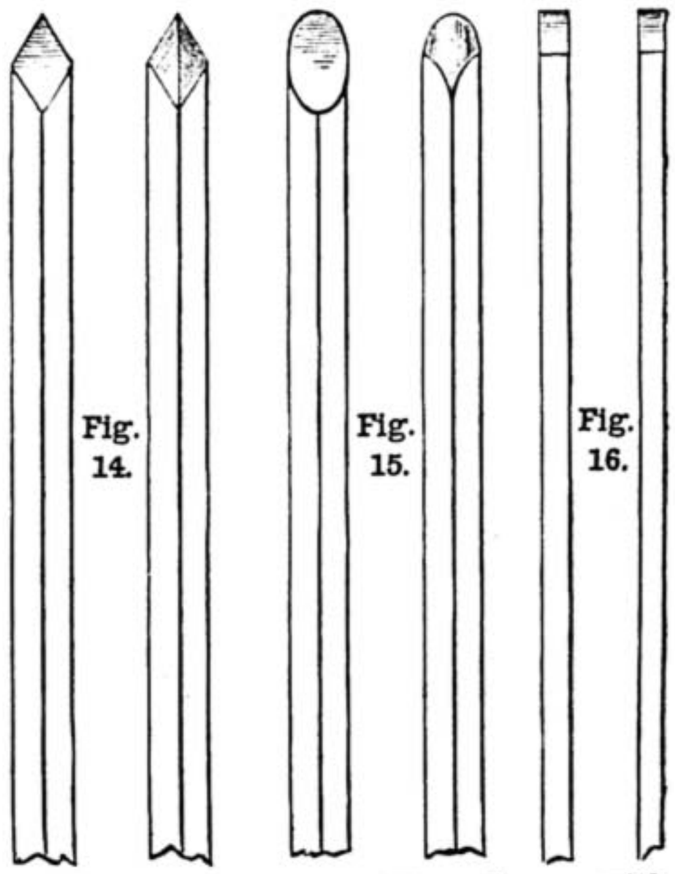

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 1.—Diagram representing Cutting from Right to Left (A B) and from Left to Right (C D). Fig. 2.—Sandbags. Fig. 3.—Short or Worn Graver with Long Handle. Fig. 4.—Long Graver with Short Handle. Fig. 5.—Arkansas Oilstone on Mahogany Block. Fig. 6.—Oil Can. Figs. 7 and 8.—Set-off Gravers. Fig. 9.—Example of Practice Plate. Fig. 10.—Flat Graver or Scorper, sometimes called a "Wriggling" Tool. Fig. 11.—Back of Shading Graver. Fig. 12.—Belly of ditto: this is Lined and Convex, and requires no Setting Off. Fig. 13.—Burnisher of Oval Section, Curved End. Fig. 14.—Back and Belly of Angle Graver for Outlining, etc. Fig. 15.—Back and Belly of Round-Nosed Graver for Spotting, etc. Fig. 16.—Back and Belly of Flat Graver.

whole of the stock of the dealer, and get him to tell you which are the hardest and which the softer stones. Choose a stone 6 in. × 2 in. × 2 in., at per pound weight. The stone should be quite white, without cracks or *yellow veins*, and of the second degree of hardness; such a stone will sharpen any tool in first-rate style, and in moderately quick time. Now take the stone to a cabinet maker, or, if the workman is handy with the chisel, he can mount the stone on a mahogany block (Fig. 5), inlaying it to the depth of ½ in., so that a *gentle tap*

Whetting or Sharpening Gravers.

The method of whetting or sharpening gravers is shown in Fig. 19.

Take a new graver, and break off half an inch of the soft end or tang as it is called; now take a handle—the shortest one you have (Fig. 4)—and gently tap the graver home in the handle, using a bit of brass to stand the point of the graver upon while driving home. A hole is usually left in the handles for this purpose. Put some oil on the stone, and with the finger lay the oil evenly all over the surface. Now take the graver in the right hand and lay it flat on the stone, the bright side or belly of the graver downwards. Place the first and second fingers of the left hand on the end of the graver to keep it in position, and raise the handle of the graver five or ten degrees, still keeping the point on the stone (Fig. 8), then turn the graver slightly inwards and commence rubbing the graver up and down the stone, keeping the tool in the *same position* until the right-hand facet is formed, and then treat the other side of the belly of the graver in like manner. If these facets are formed truly, the line of sight on the belly of the graver and the angle of the newly-formed facets will be in a straight line (Figs. 7 and 14), although of a different level, and will enable the engraver to cut a perfectly straight or circular line at will. If this angle bears to the right hand or to the left hand, it will cause the workman to be unable to follow truly the line which he wishes to cut, therefore he must whet the graver again and again until he can see the

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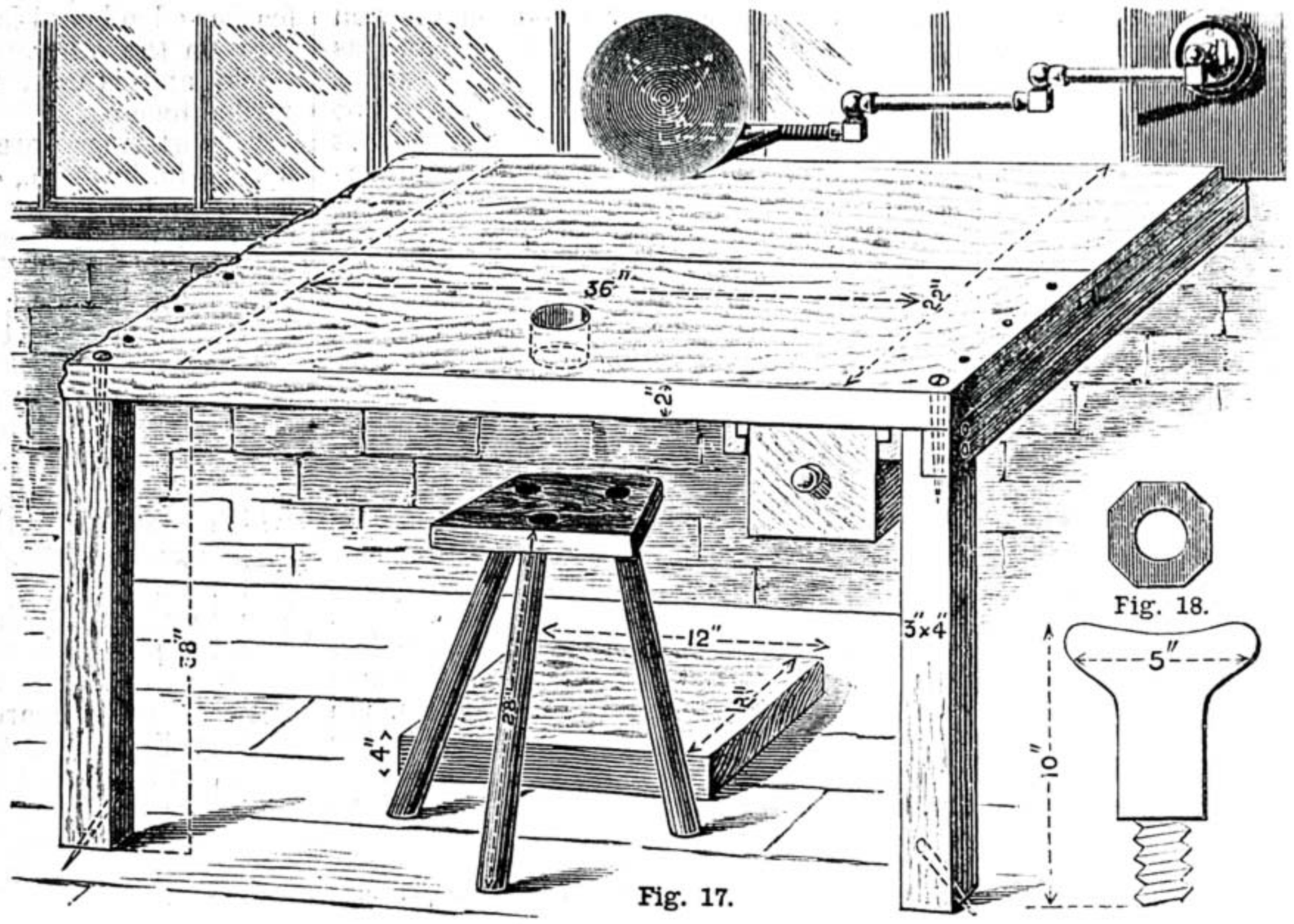

Fig. 17.

Fig. 17.—Engraving Bench, with Stool, Box for Feet, Gas Bracket, and Shade.

Fig. 18.

Fig. 18.—Block for Large Hollow Ware, as for Dish Covers, etc.

angle of his facets in line with the centre of the belly of the graver. This can be easily seen by holding the graver towards the light and looking along the belly of the graver. This is important, but after a little experience the engraver will be able to whet his tools to suit his own hand, and a little daily practice at whetting will enable him to whet a graver in a few minutes. Now turn over the graver with the newly-formed facets upwards, place the graver on the stone at an angle of 45°, and rub it on the stone until a sharp point is obtained, which may be known by trying the point on the thumb nail. If the point is dull it will slide over the surface of the nail, but if sharp it will cut the nail. Do not rub the stone always in the same place, but use it equally all over the surface, and wear the stone as evenly as possible. The operation of raising the graver handle when forming new facets is termed, "setting off" the graver, and the "set off" of a graver depends upon the kind of work to be done. Thus: the graver we have just whetted is to be used in cutting the plate we are about to mount on the cement block, therefore, being a flat surface and easily accessible, the "set off" of the graver does not require to be very great; on the other hand, if we were about to engrave the bottom of a cake basket (the bottom of which is some three or four inches deeper than the outside edge or mount), we should require a graver "set off" at an angle of 30° to 45°; and in the usual workshop economy of time, these kind of gravers are kept each for its particular purpose, so that it is quite an easy matter to have from fifty to one hundred gravers in use. These and other gravers will be dealt with further on. Meanwhile, should any young workman be unable to get over the difficulty of whetting a graver, if he will send it to me, through the Editor of WORK, I will whet for him a graver as a pattern. It is requested that the postage be paid both ways, as no charge will be made.

To return to the German silver practice plate. These plates may be obtained of a metal dealer at the rate of about 1s. 4d. per pound, according to the state of the metal market. It should be hammered flat by a silversmith, and afterwards buffed or polished, and cut into convenient sizes for mounting on the cement block. This block is a piece of mahogany, 6 in. × 6 in. × 1 in., plain sawn. The cement is called engravers' cement, and may be procured from an oil man. Should any difficulty arise, the cement can easily be made as follows:—Melt in a stone pipkin 1 lb. Swedish pitch—it can be done in an oven; when melted mix 1½ lbs. of plaster of Paris in the pitch while hot, thoroughly incorporating the mixture, and pour while in a liquid state upon the block, spreading evenly all over the surface; now warm the plate, lay it on the cement, and press it down firmly, which, when set, is ready to work upon. When another plate is required to be mounted, the cement can be warmed at the fire, or over the gas, taking care that in the latter case the cement is not smoked or burned. Take also particular care that none of the cement drops while hot upon the fingers, as it inflicts an ugly burn which takes a long time to heal. We have now the plate mounted ready to receive the design or pattern intended to be engraved.

There are many methods of teaching used by professional engravers, which, of course, vary with the individual. Some prefer to start the pupil on the work in hand, such work as tracing from the print, thus making the pupil of use from the first. Others will give the young workman a plate, such as I have described, and having whetted for him a graver, will allow him to quietly get used to the graver in his own way, giving him a few necessary directions from time to time as occasion requires. My own practice is to give to the young workman as great a variety of work as is possible, changing the character of the work frequently, so that it may not become monotonous. Thus, I give a little tracing from the print, cutting, dividing, or "setting out"

Fig. 19.—Method of Whetting Facets of Ordinary Graver.

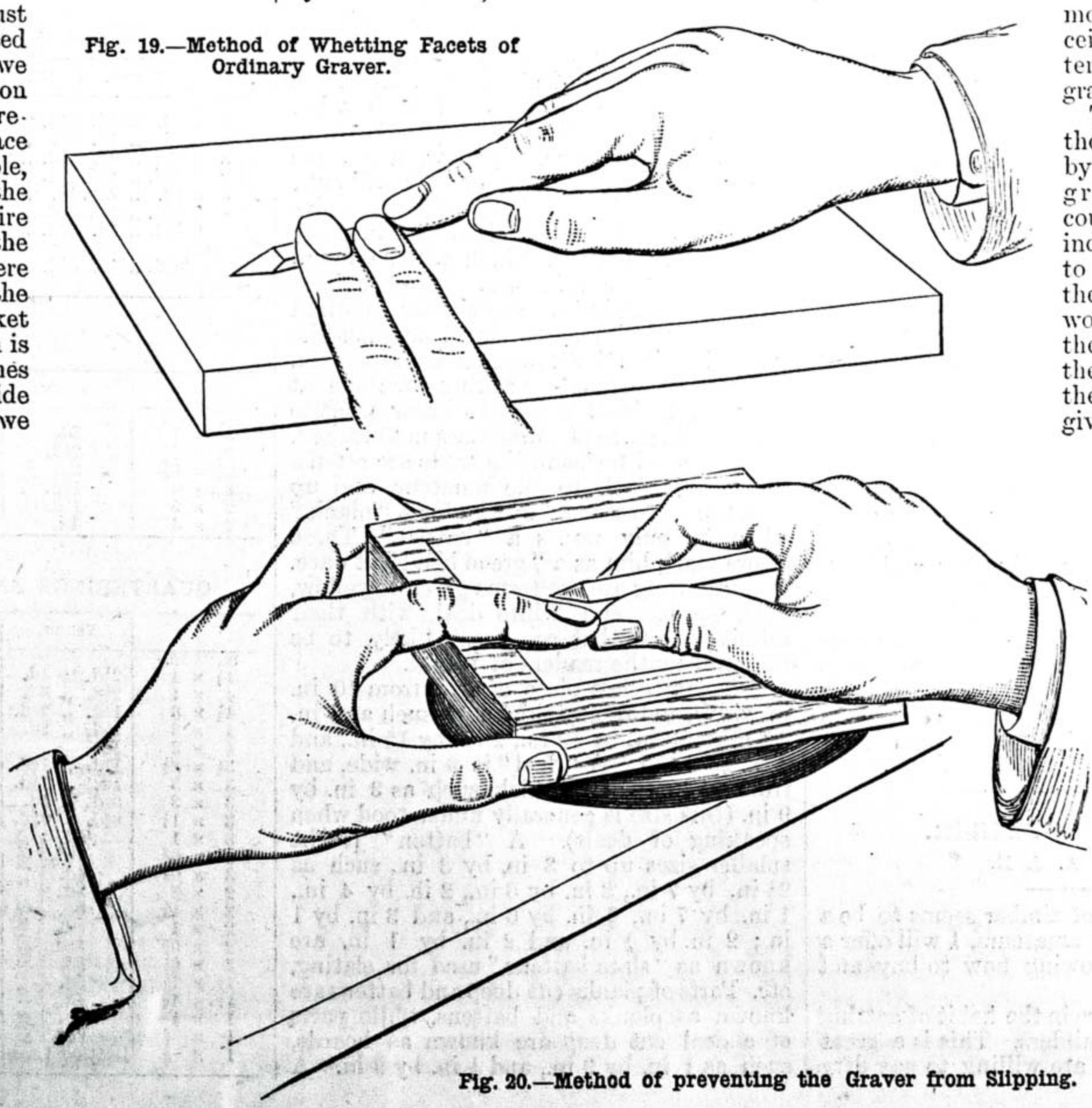

Fig. 20.—Method of preventing the Graver from Slipping.

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my own work, with proper intervals for plate practice. However, for a start, take the block and stand it upon the sandbag (second size), B, Fig. 2, and with the spring dividers find the centre in the usual manner, and strike on the plate a number of circles, increasing in size till the outside edge of the plate is reached. Now take the graver in the right hand (Fig. 20), placing the handle in the palm, grasping firmly with the forefinger and thumb. Hold the block with the second, third, and fourth fingers and thumb of the left hand. Thus we have the first finger of the left hand at liberty to place in front of the thumb of the right hand, to guard against the "slipping" of the graver. The workman will now try to cut the smallest circle described on the plate (Fig. 9). He will find this somewhat difficult at first, but with perseverance and practice will soon get into the way of holding the graver. There is nothing difficult about it, except that the holding of the graver in the hand is, perhaps, different to that of any other tool. To resume: now place the point of the graver on the line of the smallest circle, gently raising the graver and pushing it forward till the graver begins to cut. Continue the cut, gradually turning round the plate towards the right hand, cutting towards the left hand, keeping the forefinger of the left hand in contact with the thumb of the right hand. The workman will find that the thumb of the right hand will slide over the work in the rear of the cut; this being the case, a leather thumb stall had better be worn until the end of the thumb becomes hardened. As it is necessary to be able to cut from left to right, as well as from right to left, which I have just described, the second circle must be cut in the reverse direction (Fig. 1, C to D)—viz., from left to right, using the same directions as for the centre circle. By this time the graver, what with slipping about and digging into the metal, will be quite dull, so all that remains to be done to renew the point is to give the graver a few rubs on the stone with the facets upwards, keeping closely to the original angle of 45°. Continue to cut the remaining circles by the above rules. alternately cutting to the right and to the left hands respectively.

The other tools that are illustrated, but to which no special reference has been made above, are a short or worn graver with long handle (Fig. 3); flat graver or scorper, sometimes called a "wriggling" tool (Fig. 10); back and belly of shading graver (Figs. 11 and 12); burnisher of oval section (Fig. 13); back and belly of angle graver for outlining, etc. (Fig. 14); back and belly of round-nosed graver for spotting, etc. (Fig. 15); and back and belly of flat graver (Fig. 16).

Having started the workman in the practice of engraving, I will in my next paper give a few directions to those workmen who have had a little practice, and are familiar with tools, and who wish to know something about lettering on brass and zinc, pewters, etc.

PURCHASING TIMBER.

BY B. A. J. H.

As the purchasing of timber seems to be a difficulty with many amateurs, I will offer a few suggestions, showing how to buy and what to ask for.

Many amateurs are in the habit of getting their timber from builders. This is a great mistake, unless you are willing to pay fifty per cent. more for your wood than if you bought it at a retail timber yard; and as there are now so many of them about London and the provinces, there should be no difficulty in going to one to buy what you require. Of course it must be understood that amateurs cannot buy their timber at the same prices as builders do; but it is possible to get it at a much lower rate than some pay by not knowing what to ask for; and I will endeavour to show how this can be done.

Many make a great mistake by taking a piece of string or tape with knots tied marking the lengths and widths they want. No yard keeper cares for this kind of customer, and frequently has his revenge by altering the knots while the customer is examining his piece of wood. Always take a two-foot rule with you, and should the salesman ask the loan of it, "as he has lost his," be careful that you get it back, as some are not very particular to return them. On the other hand, many customers borrow the rule and forget to return it when they have finished. Avoid unnecessary details in asking for your lengths, such as 3 pieces of 32 in. long, 8 pieces 24½ in. long, etc. Work your quantities out before you go to the yard into as few lengths as possible, such as 1–17 ft. and 1–8 ft., or 2–9 ft. and 1–8 ft. This saves the salesmen a lot of trouble, which they do not care for, and will also ensure your getting the right lengths, as in cross cutting they are not particular to an inch or two, causing much inconvenience if the stuff is cut wrongly. A charge of a ½d. or 1d. is also made in some yards for cross cutting, which they charge on the amount for the timber, and so it is not noticed unless you have asked the price per foot before having the stuff cut. Do not always expect to get just the lengths you want, as few yards have the room to keep every length of all sizes in stock; so it is as well to be prepared with other lengths that will work in for your requirements. For instance, if you wanted some 4 fts. and 3 fts., either 12 ft. or 18 ft. will cut; or ask for any length that will cut. I give a list with prices of the sizes kept in stock at most retail yards, which will be found very useful as a reference. Many writers in giving details of sizes of timber required to make or build greenhouses or such-like often give sizes that are never kept in stock, and upon the amateur asking for them at the yard he is at a loss to know what to take in the place of those sizes not stocked. The technical terms in the trade are often a stumbling block to the amateur, and up goes the price when he asks for a "plank" when he only wants a "batten." These errors mark him as a "green hand" at once. The following are the terms given to yellow, pine, spruce, and white deal, with their relative sizes, that are most likely to be required by the readers of WORK.

A "plank" is a piece of deal from 10 in. in width, and of any thickness, such as ⅛ in. by 11 in., 3 in. by 10 in., 2 in. by 15 in., and 4 in. by 12 in. A "deal" is 9 in. wide, and from 2½ in. to 4 in. thick, such as 3 in. by 9 in. (this size is generally understood when speaking of deals). A "batten" is the smaller sizes up to 3 in. by 8 in., such as 2½ in. by 7 in., 2 in. by 6 in., 2 in. by 4 in., 1 in. by 7 in., ¾ in. by 6 in., and 3 in. by 1 in; 2 in. by ¾ in. and 2 in. by 1 in. are known as "slate battens," used for slating, etc. Parts of planks cut deep and battens are known as planks and battens, while parts of a deal cut deep are known as boards, such as 1 in. by 9 in., and ½ in. by 9 in. A feather-edge board is thick on one edge and thin on the other, usually ¾ in. and ¼ in. thick, and is used for roofing sheds and garden fencing.

"Quarterings" are such sizes as 4 in. by 6 in., 4 in. by 4 in., 4½ in. by 3 in., 3 in. by 3 in., and 3 in. by 2 in.; and the smaller sizes are called "scantlings," such as 2 in. by 2 in., 2 in. by 1½ in., 1½ in. by 1½ in., and 1 in. by 1 in., etc.; such sizes as 2 in. by ½ in., 2 in. by ⅛ in., 1 in. by ¼ in., are known as "laths." "Floor boards" are generally stocked in the following sizes: 1¼ in. by 6 in. and 7 in., 1 in. by 6 in., 6½ in., and 7 in., ⅞ in. by 6 in., 6½ in. by 7 in., ¾ in. by 6 in. and 7 in. Matching, that is to say, battens which match together lengthways with a groove and tongue, are 1 in., ¾ in., ⅝ in., and ½ in. in thickness, and from 4 in. to 7 in. in width. 1½ in., 1¼ in., 1 in., and ¾ in. by 9 in. planed boards are now stocked at most yards, and the difference in price between the prepared and the unprepared is very little. But in ordering all planed goods an allowance of ½ in. in width must be made on each board for the planing. The following is a list of sizes and prices, which vary according to quality.

PLANKS.

In.		In.	Yellow.	White.	Pine.	Lengths.
3	×	11	4d. to 6d.	3½d. to 4½d.	4d. to 11d.	From 6 ft. to 20 ft. Pine generally 6ft. to 12 ft.
2	×	11	3d. „ 4d.	2d. „ 3½d.	3d. „ 8d.	
1½	×	11	2½d. „ 3½d.	2d. „ 2½d.	2½d. „ 6d.	
1¼	×	11	2d. „ 3d.	1¾d. „ 2½d.	2d. „ 5d.	
1	×	11	1½d. „ 2d.	1¼d. „ 1¾d.	1¼d. „ 4d.	
¾	×	11	1¼d. „ 1¾d.	1d. „ 1½d.	1¼d. „ 3d.	
⅝	×	11	1d. „ 1½d.	1d. „ 1¼d.	1¼d. „ 2½d.	
½	×	11	1d. „ 1¼d.	0¾d. „ 1¼d.	1d. „ 2d.	
¼	×	11	—	—	9d. „ 1/4	per 12 ft.
⅛	×	11	—	—	6d. „ 10d.	„

DEALS AND BOARDS.

In.		In.	Yellow.	White.	Pine.	Lengths.
3	×	9	3d. to 6d.	2½d. to 3½d.	3d. to 8d.	6 ft. to 24 ft.
2	×	9	2d. „ 4d.	2d. „ 3d.	2d. „ 6d.	„
1½	×	9	1½d. „ 2d.	1½d. „ 2d.	1½d. „ 4d.	„
1¼	×	9	1¼d. „ 1¾d.	1¼d. „ 1½d.	1¼d. „ 3½d.	„
1	×	9	1d. „ 1½d.	1d. „ 1½d.	1d. „ 3d.	„
¾	×	9	0¾d. „ 1¼d.	0¾d. „ 1¼d.	0¾d. „ 2½d.	„
½	×	9	0⅝d. „ 1d.	0⅝d. „ 0⅝d.	0¾d. „ 1½d.	6 ft. to 18 ft.
Feather edge Boards			0⅝d. „ 1d.	0⅝d. „ 0⅞d.	—	„

BATTENS.

In.		In.	Yellow.	White.	Lengths.
3	×	7	3d.	2½d.	6 ft. to 24 ft.
2½	×	7	2½d.	1⅞d.	„
2½	×	6½	2d.	1½d.	„
2	×	6	1½d.	1⅛d.	„
2	×	5	1⅛d.	1d.	„
2	×	4	1d.	0¾d.	„

QUARTERINGS AND SCANTLINGS.

In.		In.	Yellow.	White.	Lengths.
4½	×	4	2½d. to 4d.	—	6 ft. to 24 ft.
4	×	4	2½d. „ 3d.	—	„
4½	×	3	1½d. „ 2½d.	1½d. to 2d.	„
4	×	3	1½d. „ 2d.	1½d. „ 2d.	„
4	×	2	1d.	0¾d.	„
3½	×	2½	1½d. „ 1½d.	1d. „ 1½d.	„
3	×	3	1d. „ 1½d.	1d. „ 1½d.	„
3	×	2	0¾d. „ 1d.	0¾d. „ 1d.	„
3	×	1½	0⅝d. „ 0¾d.	0¾d. „ 0¾d.	„
3	×	1	5d.	per 12 ft.	length.
3	×	0¾	4½d.	„	„
3	×	0½	4d.	„	„
2	×	2	8d.	„	„
2	×	1½	6d.	„	„
2	×	1	4d.	„	„
2	×	0¾	3½d.	„	„
2	×	0½	3d.	„	„
1½	×	1½	5d.	„	„
1¼	×	1¼	4d.	„	„
1	×	1	3d.	„	„
1	×	¾	2½d.	„	„
1	×	½	Lattice Lath	1s.	144 ft. run.

(Cut in yellow & white.)

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FLOORINGS AND MATCHINGS.

	Width.	Lengths.	Yellow.	White.
	In. In.	Ft. Ft.		
1¼ Flooring per square.	5 to 7	6 to 24	12/- to 18/-	10/- to 14/-
1 ,,	,,	,,	9/6 ,, 14/-	9/- ,, 12/-
¾ ,,	,,	,,	8/6 ,, 11/-	8/0 ,, 10/6
½ ,,	,,	,,	7/6 ,, 9/-	7/6 ,, 8/6
1 Matchings	,,	,,	10/- ,, 14/-	9/- ,, 12/-
¾ ,,	,,	,,	7/6 ,, 9/6	7/- ,, 8/6
½ ,,	,,	,,	7/- ,, 8/9	7/- ,, 8/-
¼ ,,	,,	,,	6/9 ,, 8/6	6/6 ,, 8/-

TABLE SHOWING NUMBER OF FEET RUN TO THE SQUARE.

Width.	Feet run.	Width.	Feet run.
In.	Ft.	In.	Ft.
4	300	6¾	185
4½	270	7	180
5	240	7½	170
5¼	230	8	160
5½	220	8½	150
5¾	210	9	140
6¼	200	9½	130
6½	190	12	100

If several lengths of one size are required, it is cheaper to buy the planks or deals cut instead of buying them as boards or scantlings. For instance, say you want three 12 ft. 1 in. by 9 in., ask for 12 ft. 3 in. by 9 in., 2 in. deep., *i.e.*, a 12 ft. of 3 in. by 9 in. with two equal cuts through the 9 in., making three 1 in. boards; or six ½ in. by 9 in. ask for a five-cut deal; four ¾ in. by 11 in. ask for a three-cut plank.

In quartering or scantling the deals are cut "flat," *i.e.*, through the 3 in., thus: one flat cut 3 in. by 9 in. = two 4½ in. by 3 in.; two flat = three 3 in. by 3 in.; or one deep and five flat — twelve 1½ in. and 1½ in., and so on. A lower rate is generally charged if the deal is taken, as it does not leave the yard keeper a lot of odd boards, mostly "outside" ones (*i.e.*, those boards cut from the outside of the deal, the rest being known as "inside;" thus there are two "outside" and one "inside" board in a two-cut deal), to get rid of.

The usual price charged for cutting is 3d. per 12 ft. deep cut 9 in., and 1s. per 100 ft. 3 in. flatting; so in asking for three 12 ft. 1 in. by 9 in. you would be charged 1s. 3d. each, while for a two-cut deal (*i.e.*, the same under another name), the price is 3s. 6d.; being 3d. per foot for the 3 in. by 9 in., and 3d. per cut.

Most yards stock pine, yellow, white, and spruce, and sometimes mahogany; but you will find that you can buy the hard woods, such as mahogany, walnut, oak, beech, etc., better and cheaper at those yards where only hard woods are kept. These are sold at per foot super, the price varying according to the figure in the wood. Timber merchants, as a rule, deliver free any reasonable distance if a fair amount is ordered, say 10s. or 15s. worth, although such orders as 5s. are sent home if near the yard.

OUR GUIDE TO GOOD THINGS.

Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.

100.—NURSE'S REGULATOR.

THAT everything comes, sooner or later, to him who is willing to wait for what he wants, is a saying which borders very closely on being an actual and positive truth, and one with which I have often effectually consoled myself when placed in a position of desire and difficulty, and have endeavoured to console many of my readers who labour under the impression that their wants are neglected and their wishes ignored, because they do not get what they ask for immediately after the ceremony of asking has been performed. Now, for years I have been waiting very patiently for a contrivance that would adjust the plane-iron in any wooden plane as perfectly as it is done in some iron planes of American origin, and I have met with it at last in Nurse's Regulator, which satisfies all my wants and wishes in this respect and leaves nothing to be desired.

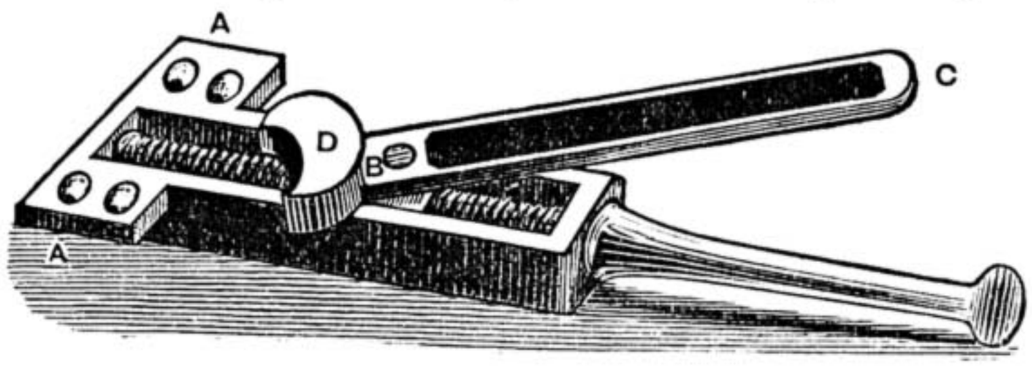

Fig. 1.—Nurse's Regulator for Adjusting Plane Irons.

When I first saw the invention which has been introduced by Messrs. Charles Nurse and Co., Plane Makers and Tool Merchants, 182, Walworth Road, London, S.E., the brass thumb-screw, which shows itself above the top of the plane iron, as may be seen on reference to Fig. 2, put me very much in mind of another plane similarly fitted, to all appearance, which was introduced some years ago, and which, at first sight, I thought likely to answer the end in view, but when I came to remove the wedge and plane iron from the specimen plane sent me by Mr. Nurse and examine the regulator, it soon appeared that the similarity which seemed to exist between the two planes was apparent only, and by no means an actuality. The plane of which I am speaking was an iron plane with a single plane iron, and a piece about ½ in. wide and 2½ in. long was cut in the upper part of the plane iron in the direction of its length to admit of its passage up and down on either side of a piece of iron projecting from the plate on which the plane iron rested, and which carried a screw which worked in a bar with nut in its projecting centre in which the screw worked, and by means of which the plane iron was adjusted. The worst feature of the plane was that the adjusting screw was not made as nicely and truly as it might have been, and the consequence was that the adjustment when effected was soon liable to derangement.

Now I must confess myself to having a strong preference for wooden planes, and a great disinclination to use an iron plane if a wooden one was within reach, but there is a good deal of trying and tapping and looking along the sole of a wooden plane when the iron has to be adjusted, which is simply a matter of course to a professional workman who is handling a plane pretty well every day and all day, but which is decidedly troublesome to an amateur with a minimum of practice, especially if his sight is not so good and keen as it used to be in days gone by. One of the principal reasons for the extensive sale of the American made iron planes in this country has been the ease with which their cutting irons can be adjusted to their work without having recourse to the use of the hammer, and the object of the present invention is to make the ordinary wooden-bodied bench planes, so generally in use throughout this country, equal to the very best American iron planes, as regards the ease with which the cutting irons can be adjusted whilst retaining the distinctive advantages of wooden planes over metal ones.

The general design of the invention is shown very clearly in Figs. 1 and 2, of which Fig. 1 shows the regulator itself and its general appearance, and Fig. 2, by means of a sectional drawing, its mode of application to the plane. Every one who has used a plane and removed the iron for the purpose of sharpening it, will remember that there is a groove in the body of the plane behind the plane iron in which the head of the short screw that holds the two irons together is received. The top of this groove is widened by cutting away a little of the wood on each side to receive the flanges, projecting from the bottom of the brass framework of the regulator as shown at A A in Fig. 1. These flanges are fastened to the body of the plane with brass screws. Lengthways through the frame passes a $\frac{3}{16}$-in. screw, secured both at top and bottom, and terminating at the top in a thumb-piece by which it is worked. Upon this screw works a nut, not very perceptible in the drawing, from which projects a small circular plug, B, by means of which the lever, C, is riveted to the nut, and on which it turns. At the lower end of the lever is a raised semicircular or rather crescent-shaped disc, D, which fits into the round eye-hole always found in planed irons of the English pattern at the upper end of the slot, by which the cutting iron is enabled to be brought down below the edge of the upper iron as it gets ground away, and also to admit of the proper adjustment of the two irons for finer or coarser work. By means of the screw, the plane iron can be easily raised or lowered, as may be required, the lever being used to the parallelism, or otherwise as desired of the edge of the cutting iron with the mouth of the plane. This will be clearly understood by reference to Fig. 2, in which the body of the plane, the wedge, the double-plane iron, and the regulator, properly fitted to the plane, are shown in section. It will be noticed that the planes made by Messrs. Nurse & Co. are fitted with a scroll wedge to allow of its easy removal with a slight tap or two of the hammer. The distinctive feature of the regulator is that it can be easily applied to any bench plane, whether smoothing plane, jack plane, or trying plane, it not being in any way needful that it must be a plane of Messrs. Nurse and Co.'s make to which it is applied. The price of the regulator is only 2s., or 2s. 3d. post free.

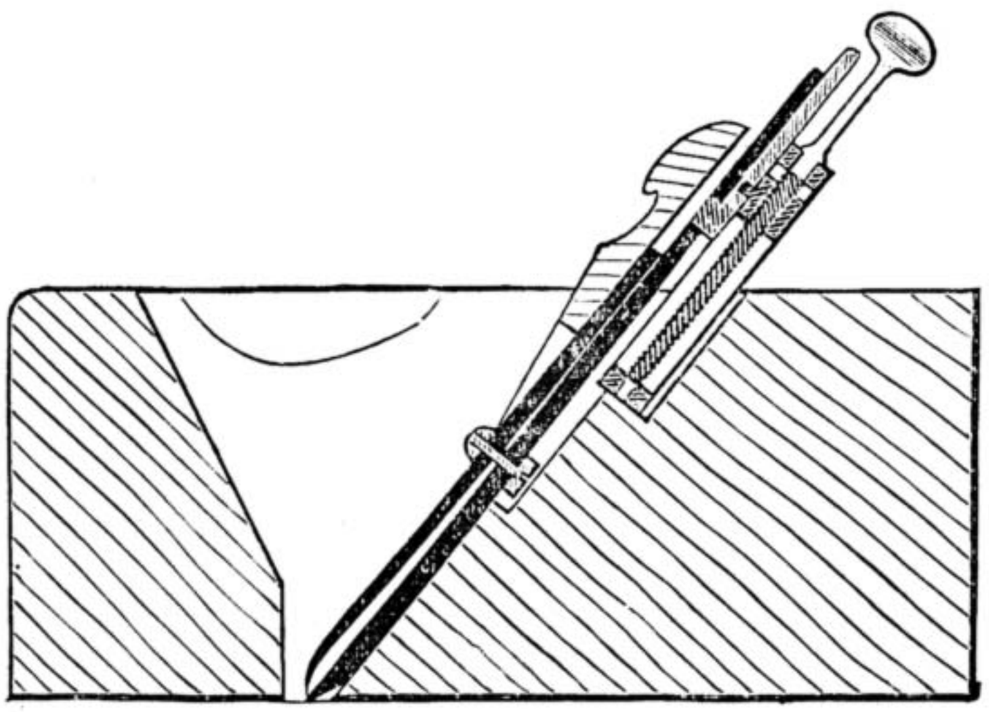

Fig. 2.—Section of Smoothing Plane fitted with Regulator.

I daresay many of my professional readers are well acquainted with Messrs. Nurse & Co.'s name as plane makers, and are quite aware that their name when attached to any tool is an absolute guarantee of its goodness. I heartily wish every tool maker would brand his tools with his own name and not with the names of the retail dealers who merely sell them. Messrs. Nurse & Co. have been plane makers, first at Maidstone and now in London, since 1841. At the International Exhibition of 1862 they obtained honourable mention for the superior workmanship shown in their planes.

THE EDITOR.

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SHOP:

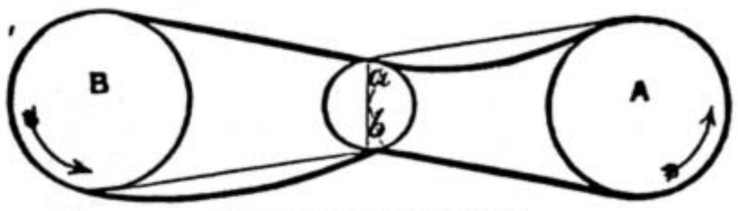
A Corner for Those who Want to Talk It.

⁂ Notice to Correspondents.—*In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of* Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Elizabethan Twist.—C. C. E. (*Lincoln*) writes:—"The letter from W. P. W. (page 332) is about a fortnight after date. I have before me, by the courtesy of W. P. W., the piece of pine therein mentioned, which is in no sense an Elizabethan twist. Also I have a spiral cut for me in mahogany, which, though a credit to his ingenuity, is not one either. It seems that we need a definition of an Elizabethan twist. I am informed on the highest authority that it is of Italian origin, and was introduced into England in Elizabeth's reign, and so much adopted for furniture that it received her name. I have specimens of it in chairs made in Italy, and also in others made in her reign. It may be described as a cylinder wound around itself, the whole spiral twisted around an axis contained within itself—the spiral being of such a rate or pitch that one complete revolution extends a length along the said axis, not less than twice its own diameter, and the spiral is such that any section taken at right angles to its own axis or path will be a circle. When I spoke of making a convex curve die into a concave without a break, I was, of course, referring to the twist under discussion, for the operation with a double quarter hollow drill or cutter, for any one definite size, is one of the easiest to any fairly-advanced amateur. The 'pea' in dispute will take a great amount of 'shelling' even by W. P. W. There is, as I intimated in a previous note, no probable difficulty in producing the Elizabethan twist—viz., in a copying lathe, having an iron copy for each rate of twist; but this is not within the compass of an amateur's lathe, and twist from a copying lathe would need, like spokes and gunstocks, to be finished by rasps, files, paper, etc. The work then ceases to be legitimate turning."

Saw Belts Slipping.—J. P. A. (*Walthamstow*) writes *re* belts slipping (page 365, No. 23):—"There is a point not mentioned that is as important as any—that is, the loose side should always be on the top, then the greater the strain the more bite the



Saw Belts Slipping.

belt gets of the pulley, whereas if the loose side is at the bottom there is the more strain, and the less hold the belt gets of the pulley. In the sketch the hold from A is increased by *a*, and from B decreased by *b*."

About Work.—A. B. (*Chatham*) writes:—"I quite agree with Kildonan in his protest against enlarging Work and the price. A penny is within the reach of all, and no workman minds paying that for a paper in which he takes an interest; but when it is above that figure, he soon begins to mutter about his not being able to 'run to it,' and 'let them have it that can afford it.' Work is a most valuable paper for the working classes, and, I think, intended for their benefit. I think, therefore, nothing should be done to place it beyond their reach. If not at present, Work will eventually derive its greatest number of subscribers from the poorer classes, and their numbers will more than compensate you for the loss of a few 'imitation gents,' whose hardest work is the bit of carpentering they do for amusement. Those who wish to keep their papers for binding, can easily sew on a cover made of brown paper or newspaper, which would keep their paper quite as clean as a tinted cover from the publisher, and the advertisement page could be pasted over with a picture or drawing. I trust you will not give way to those selfish people who want the paper filled with articles on their own particular trade or hobby; nor do I consider it a good suggestion to give designs and plans of houses, for although a man may make his own boots, clothes, tables, etc., there are very few who have either the time or money to build their own houses. I have now a few suggestions to make in regard to the articles in Work. They are that, while you are giving us lessons in the iron and wood trades, you will not forget those that more nearly affect the home of the humble bread-winner. I refer to the tailoring and shoemaking. When I inform you that I am a journeyman baker, you will not think I am speaking from altogether selfish motives; but how many poor men are there like myself who are always wanting their boots repaired, but can ill afford the three or four shillings charged by the shoemaker? With a piece of leather and a few nails (costing about tenpence), and a few directions in Work, the job is done. Then, again, we could often convert an old suit of clothes of our own into a new one for 'the boy,' if we were only taught how to do it. And lastly, if you would teach us to rivet together our broken earthenware and glass, you will be conferring a great benefit on the hard-working poor."

Combined Bench and Tool Chest.—Mancuniam (*Manchester*) writes:—"I first came across Work by accident, as I was looking for another paper, when I was attracted by the placard of No. 1. So I bought one, and could see it was just the thing I wanted, as I take delight in such things as a hobby. My earlier attempts have been small things, such as a match holder to hang on the wall, or pipe rack, etc., which I have made with a knife: but since reading Work I have got to understand the use of tools, and have bought some secondhand, as I could not afford to buy new ones. The drawing shown in Fig. 1 is what I have made with them;

Fig. 1.

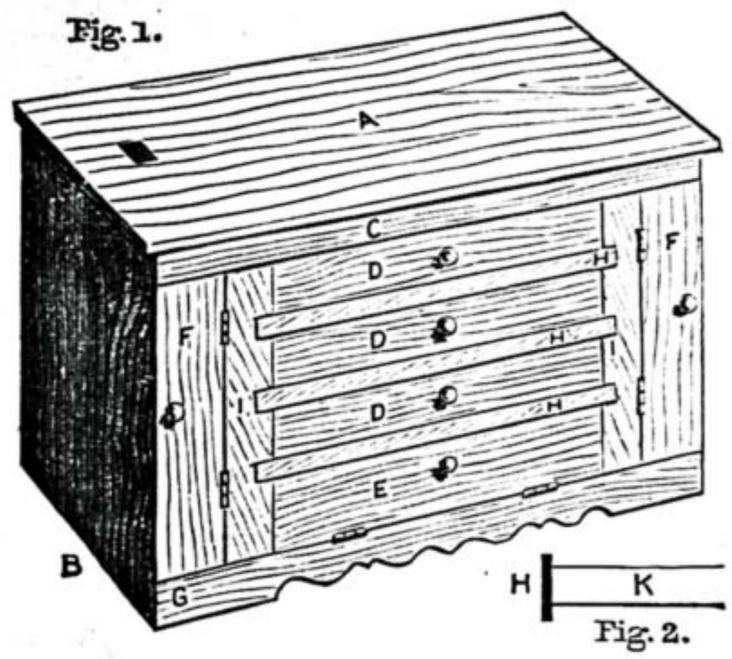


Fig. 2.

Combined Bench and Tool Chest.

the idea is from Melhuish's Illustration of Tool Cabinet and Work Bench, on advertisement page, which shows that the page is not useless, even to those who can't buy the articles thereon, as some readers complain. It is fastened together by screws, which are sunk below the surface of the wood, then round pieces of wood are glued and forced in, so that the surface is not disfigured; the drawers come over the recess as in Fig. 2, in which H is front of drawer and K the recess. B, C, G are mitred where they meet one another, as is also F, where it meets B, so as to take away the bad look it would have if made to show the cross grain, as I have no bench holder to keep it steady while I plane it. The following is the explanation of Fig. 1:—

A is the bench top with stop, size 48 in. × 14 in. × 1 in.
B " sides, 13 in. × 28½ × 1 in.
C " rail mitred to B, 44 in. × 4 in. × 1 in.
D " drawers, inside measurement, 22 in. × 11½ in. × 3½ in., one of them 4 in. deep.
E " bottom cupboard, 25 in. × 12 in. × 6½ in. deep.
F " side cupboard mitred where door fits B, 25 in. × 7½ in. × 12 in.
G " bottom rail mitred at ends, 44 in. × 5 in. × 1 in.
H " three rails let in I to divide drawers, 24 in. × 1½ in. × 1½ in.
I " two uprights that F is hinged to, 19½ in. × 4 in. × 1 in.

I hope this may be of some use to other readers. If, in consequence of my not having been quite plain enough, any reader should want to know anything I may not have sufficiently explained, if they will ask, through 'Shop,' I will tell them to the best of my ability."

Simple Mode of Inlaying.—Draper (*Laurencekirk*) writes:—"I offer to those who use the fret saw a simple and effective mode of inlaying, by which I think the veriest tyro will be able to produce pleasing results, and at the same time have the extra pleasure of making his own designs; here

Simple Mode of Inlaying.

is one for a photo frame. For this design take a piece of ⅛ in. oak with rich figure, paste on design with strong starch; pierce small holes at a point in the leaves, and cut out with finest fret saw; put the cut-out patterns in an air-tight tin or box, with a piece of ammonia, and allow them to remain in the box, say, overnight; then glue the edges well (Lépage's liquid glue is the best), and insert the pieces in their respective places. Take a little fret saw dust, and rub well in to fill up the space made by the saw in cutting. See your frame is lying quite level before you leave it to set; after it is quite dry, sandpaper smooth and French polish. Before you glue in the fumigated pieces, allow them to lie exposed for a day, otherwise they will darken the body of the wood. The axe and handle might be fumigated, or a pleasing effect is given by coating the axe with 'diamond' silver powder. If the frame is made of mahogany, darken the leaves by saturating in lime water."

Stencil Cutting.—J. F. (*Elgin, N.B.*) writes:—"I see in No. 23 of Work instructions as to cutting out of stencils (see page 361). I have nothing to say by way of correction as to the method described by R. A., only I find a far simpler and quicker plan which I have done successfully, so I write to explain it should you think it worth your trouble. I should say first it will only be of use when it is zinc that the stencil is to be cut out of. Take a piece of zinc, and instead of painting on the letters, leave them clear, painting all the rest of the zinc, as likewise the ties (it is black japan I use). When it is dry, place it (the zinc) over a basin (earthenware) and pour on a quantity of raw spirits of salt; the letters being clear will fall through as the spirit eats into the zinc; then wash off the acid, and finish off the burr with a sharp knife. I omitted to say, before japanning the zinc, it has to be set up ¼ in. all round, and corners soldered. I hope this may be of some use to some of my brother tradesmen. Now, dear sir, what about sheet metal workings? Are we ever to be favoured with anything practical on the above? It is long since it was to appear, but it seems as far away as ever, while things promised but quite recently have appeared, as also things that were never asked for. It is all very well those lessons on soldering for amateurs, but it won't do for those who have learned, or are learning, the art; there is not one apprentice that I have come in contact with but knows all that has been related in those papers before he has been one year at his trade. This with all deference to Work, which I appreciate."

Battlesden Cart.—Homespun (*Tenterden*) writes in reply to Opifex (see page 295):—"In the first place I should recommend the worker to make a full-size working drawing, with chalk, on a plastered wall, or any suitable place, showing both side and back sections; this is of the greatest importance. To draw the wheel, first find the centre, in which drive a bradawl or wire nail, then with a piece of string, and chalk, draw a circle the required size, from which you will be able to see if the cart is likely to balance when finished. While making this drawing, I shall expect the worker to make many alterations until it is to his own satisfaction; when finished he will be able to get all his bevels with the greatest ease. I must now call your attention to Fig. 17 (details Battlesden cart, July 27th): If the seat-rail was 4 in. wide in place of 3 in., it could be screwed on the top of solid sides, which would make the cart deeper if required. If an extra length were left on the bottom of Fig. 13, and turned to the required angle, to screw to the solid side, Fig. 18 would not be required. Before fixing the top sides, or rails, wet them on the in or convex side, holding the outside to the fire; they then can be bent to the required sweep, and fixed without fear of splitting. Over the screws tack a wood valance 2 in. wide and ⅜ in. thick, plane outside, chamfered to ¼ in. at top edge on inside as per section (Fig. 23). Before hanging the tailboard, please read, mark, learn, and inwardly digest the chapters on butts in a previous issue. Previous to fixing the dash, it would be advisable to fix two plates, called bracket plates, made of half round iron ⅜ in. thick, and about ⅝ in. wide, to go about 6 in. on front, to hold front corner together, and prevent corner from splitting at A (Fig. 4). The transom, or shaft bar, should be mortised into the shaft ¼ in., no more, to prevent it from shifting, as shown (Fig. 10). I should recommend side springs with 3 in. more compass, and a spring block 2 in. deep in the place of 5 in. With his 5 in. block I do not wonder he recommends a solid flap axle, or the spring clips would soon get loose, and the cart would rock about. If any of our readers have succeeded in making a cart from the instructions given by Mr. Opifex, I am certain that they could make their own wheels, and box them, so as to have a vehicle of their own construction. If no abler pen than mine takes the matter up, it would be my greatest pleasure to assist them. I do not wish to commence a hair-splitting controversy, or throw cold water on Mr. Opifex's good intentions; what I write is for the benefit of those who are willing to learn."

An Easily-Made Fret Machine.—E. J. A. (*Reading*) writes:—"In Work for August 10th (No. 21, page 332), W. R. S. has described (?) an easily-made fret machine. I am more than surprised that an Editor of a magazine printed and published by Cassell & Co. should have allowed so much valuable space to have been wasted with a description of such a machine. [Are you? Read on a little further.—Ed.]. How and where is the wheel to be fixed? How, in the name of common

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sense, can W. R. S. get a vertical stroke if the bar, A, is joined to the arm, C? I can understand its working if the end of the brass bar were made with a straight slot; but in the machine under notice, if the iron guides, B, B, are fixed, I fail to see how W. R. S. can get any stroke. I hope W. R. S. will see the error of his ways."

An Easily-Made Fret Machine.—W. R. S. (*Brixton*) writes:—"HIGHBURY, N., in page 411, says that if the above machine was made according to the illustration it would be impossible to work. He is quite mistaken, considering that the original from which the illustration was drawn has been in use for over twelve months. I shall be quite willing to show it to him at any time he may mention (the Editor has my address). Meanwhile I am anxiously waiting to see the sketch of the machine as corrected by him, asked for by the Editor on page 411."

An Easily-Made Fret Machine.—W. R. S. (*Brixton*) writes in reply to ANXIOUS (*Barnoldswick*) (see page 411):—"You ask how the fly wheel should be suspended. The axle should be fastened firmly to a bench so as to allow the wheel to work easily. In reply to how long the bars of iron should be, mine are eight inches, but they could be made whatever length would be suitable for fixing them. They are both fastened down to a framework, which does not appear in the illustration, and which he must use his own discretion in making. He must remember that the better the pipe, A, works in these bearings the more successful will the machine be. I hope this will fully explain any difficulties which he may have met with, and will be glad to know if he is successful in making the machine."

An Easily-Made Fret Machine.—W. R. S. (*Brixton*) writes in reply to MANCUNIAM (*Manchester*) (see page 412):—"You ask how does C cause A to work vertically? The bottom part of C is fastened to the wheel, and the top part only to the shaft, so that when the wheel revolves the treadle crank pushes up A till it gets to the top, when the crank draws it down, and so on."

Cane Furniture.—J. P. A. writes:—"I made a window stand for flower-pots out of the canes sold for garden sticks. Some were ¾ in. in diameter and some ⅝ in. Generally there have been six 5-in. pots on each shelf for months, so it bears some weight, and I do not suppose it cost 2s. altogether. I will give my experience on that job, if you think it worth while."—[By all means give your experience in this particular branch of work.—ED.]

Harmonium as Blast for Furnace.—G. H. (*Bradford*) writes:—"No doubt many readers of WORK possess a harmonium or American organ, which they have never dreamt of using for purposes other than charming the savages next door. I am in possession of a small harmonium, and some time ago, wishing to make some brass castings, I conceived the idea of making it act as a blast for my furnace—the kitchen fire. Acting on the spur of the moment I placed the instrument with its back to the fire, bored a hole 1 in. diameter into the reservoir, inserted an iron pipe 6 ft. long, one end of which I put between the bars of the grate, and I had a powerful continuous blast. I have since fitted pipes with suitable bends and couplings, so that my box of music can retain its normal position, and I can at any time attach suitable jets for smelting, smiths' work, brazing, or glass blowing. Further particulars if desired."—[If I possessed a harmonium or American organ I should certainly refrain from treating it as you have treated yours; but, nevertheless, there may be some who might be inclined to follow your example, so I give the latter portion of your letter. The first part I am compelled to omit, partly through want of room, and partly because it would serve no useful purpose to put it into type.—ED.]

Flat or Dead Black.—In reply to F. P. (*Newport, Mon.*) (page 334) OPIFEX writes:—"This correspondent has written a long objection—occupying eighteen lines in 'Shop'—to my 'tip' for quick drying flat black (see page 218), which he characterises as a 'roundabout recipe,' yet it occupies only three and a half lines in the larger type of the other columns of WORK. But although this hundred-galloner grumbles, my poor little tip survives unaltered, as by F. P.'s showing—and he is a professional—drop black, turpentine, and black japan are correct ingredients, for though he substitutes gold size as a binder, and suggests 'any copal oil varnish' as an alternative, which will answer equally well, every one who knows the composition of black japan is aware that it also will answer equally as well as any of the binders mentioned. On the whole, I am obliged to F. P. for his growl, also for having corrected me as to the name of the black. I certainly ought to have written 'drop ivory black,' but thought at the time that every one knew it familiarly as drop black. With regard to the direction that the black should be 'purchased already ground in turpentine,' allow me to point out that amateurs, for whose benefit 'Tips for Tyros' are chiefly intended, do not generally make up their quick black by the 100 gallons, and that it will, therefore, suit them better to grind what they require as they need it. I am sorry to take up so much space in defending my 'tip' from assault, and only hope that all its brethren may prove as much in accordance with 'the results of practical and professional experience and usage' as F. P. has shown this one to be."

Cheap Bell Chuck.—I. L. (*Glasgow*) writes:—"Referring to your article 'A Cheap Bell Chuck,' I would suggest that a diminishing coupling be got from the pipe works without being screwed, or if the tap be sent to the works the smaller end will be screwed by the make, and the larger end left plain; this would give additional strength for screws. Any size can be got on ten minutes' notice; at least it can be got in Glasgow."

Frame for Wardian Case.—J. N. M. (*Salford*) writes with reference to remarks on this subject by W. P. (*Southport*) in No. 19, page 301:—"I have been hoping to see in WORK something about a wardian case, and having just received my monthly number I have found what I wanted, but not enough of it. I should take it as a favour—and possibly others would—if our friend, W. P. (*Southport*), would explain the *joints* he uses to connect (1) The base of the case. (2) The corner upright astragals to the base. (3) The corner upright astragals to the horizontal astragals. (4) The bevelled astragals to the base and top respectively of the wardian case top. Possibly small diagrams would save much writing and space."

Hand Saw Bench.—J. L. (*Elgin*) writes in reply to B. F. (*Liverpool*) (see page 382):—"I notice in 'Shop' a description of hand saw bench in which an error has crept in which would overthrow the very first principles of applied mechanics. B. F. says (or is made to say) 'the smaller the pulleys are the greater the speed on saw, but the larger they are the less power.' Surely this is quite the opposite of what he means for as you lose speed, by using larger pulleys, this will cause a gain of power. I have a bench of same make (my own) by which I do five different processes—viz., ripping, squaring, grooving, beading, and tenon cutting."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Emery Wheel.—J. C. (*Hull*).—You can buy an emery wheel much cheaper and far superior to any that you could make. If you attempt it you will probably have the fragments flying about your head. Churchill, or Buck & Hickman, or Selig Sonnenthal can supply what you require.—J.

Galvanometer.—W. G. G. (*Brighton*). A fully-illustrated description of a galvanometer will be forthcoming in WORK when room can be spared for the article. The construction of coils and galvanic batteries will also receive attention in due time. Space cannot be taken up in "Shop" in showing how to construct galvanometers, coils, and batteries.—G. E. B.

Edison's Chronograph.—R. D. (*Paisley*).—I am told that the needle or stylus in Edison's new phonograph is made of steel, and is fixed to a mica diaphragm by means of a very small nut and screw. Perhaps some reader will kindly oblige R. D. with a detailed account of the diaphragm and stylus of Edison's new phonograph.—G. E. B.

Tire Cement.—BICYCLE (*Rainham*).—A fairly good tire cement at 1s. per lb. from W. A. Lloyd, Waeman Street, Birmingham. Holdtight cement, 1s. 6d. per lb., from Wm. Bown, 308, Sumner Lane, Birmingham. Rockhill's cement, 4s. per lb., Wm. Bown as above.—A. S.

Watch Materials.—PORT VICTORIA (*Rochester*).—You can get eyeglasses and watchsprings at Grimshaw's & Co., 35, Goswell Road, Clerkenwell, or at any of the tool shops in Clerkenwell. The best eyeglass I find is the cork frame; they are lighter to hold up, and give to the shape of the eye, and if dropped does not chip like the horn frame. The price is about 1s. each, the horn being about 10d. each. Any material may be had same place.—A. B. C.

Wood.—A. W. (*Hampstead*).—Messrs. R. Melhuish & Sons, Fetter Lane, London, E.C., would probably be able to supply the wood you require. Some years ago S. A. Mitchell, 100, Curtain Road, E.C., used to sell me similar wood, but having no occasion to send him orders lately, I cannot say whether the address would find him now; his prices were reasonable, and the stuff always correct to order, and satisfactory in every respect.—E. B. S.

Mechanics.—NEMESIS (*Manchester*).—The following are two suitable books upon the subjects you refer to:—(1) "Practical Mechanics," by Prof. Perry (3s. 6d.), Cassell. (2) The above, and Rankine's "Civil Engineering," 12s. 6d., Griffin & Co., 12, Exeter Street, Strand, London.—F. J. C.

Painting Iron Bedsteads.—J. R. (*Liverpool*). If, as I presume, you have no facilities for japaning your iron bedsteads, you cannot do better than renovate them with enamel paint. I do not know that any one brand of these has a superiority over all others, so that it would be invidious to name one make to the exclusion of others. If you want to encourage local manufactures, get the "Falcon" brand. Minton's is also another local make. You will find either of these enamels quite equal to Aspinall's, which needs no comment. At Lewis's you will get yet another make, so that you have a choice of at least four, all of which I can recommend from personal use, but I cannot take upon myself to say that one is "the best." There is no particular mode of application that I can tell you of, as I suppose you know enamel, like other paint, is laid on with a brush. Be careful to remove any traces of grease from the work before painting, and if the previous coating is chipped, smooth it down.—D. A.

Hairspring Fixing.—THIRTY-HOUR MOVEMENT (*Liverpool*).—I have always the same difficulty in getting a new hairspring for any of those American movements, and from your query I should say your spring is very much too strong; try and change it for one much weaker at the shop you bought it. If you cannot get one weak enough take the spring from the brass collet in the centre, get a cork larger than the diameter of the spring, and put the spring on a sharp cutting oilstone, and grind the spring down; the cork will keep it flat on the stone. This is a quick and easy plan of weakening a spring, either stock or watch, although it makes the spring narrower, and is inclined to make it wobble in working, unless done carefully. In grinding, press firmly on the cork, and work it in a circular manner, and use plenty of oil with a little paraffin in it, then clean in benzoline, and repeat the dose till going to time; if not successful write again.—A. B. C.

Simple Subjects.—C. E. (*Lydney*).—Your letter is one I should much like to answer with some advantage to yourself, but it is by no means easy to do so, as though you want a description of something simple, you do not say in what craft or trade you want assistance. From what you say I may assume you would find working in wood, *i.e.*, joinery, cabinet making, carving, etc., the most suitable subjects to take up. Of course we want to encourage rising talent, but at your age you really cannot expect to be able to make much. Being, as you say, only thirteen years old, you naturally have still to acquire the very rudiments of tool handling and working, and much as we should like to help you we really cannot devote much space to describing such very trifling things as it may fairly be imagined are within your comprehension and ability. Take my advice if you will, and read WORK carefully. Much that appears in it is doubtless beyond you now, but then, you know, you are not always going to remain "only thirteen," and with increasing years no doubt you will acquire increasing powers. Although you may not yet be able to make many, or even any, of the things described in WORK, you will gain a fund of information which is sure to come in useful when you reach the years of manhood; and I am sure so sensible a lad as you will not be discouraged at being told you must learn the rudiments before you can hope to achieve success. Now supposing you read our articles on jointing up, and put in practice the directions given—in other words, try your hand at joining boards by the methods described. Though you may not by so doing make anything, you are learning a most useful lesson, which will stand you in good stead when you undertake to make a piece of furniture. Certain tools are mentioned in the articles referred to: get and become proficient in them. In "Lessons from an Old Bureau" you will also learn a good deal, though you may not be able to make a bureau yet. In fact, the same may be said about any of the articles which have already appeared or will appear in due course. Try your hand at making a box, and put in practice the remarks about dovetailing, which you will find in connection with the drawers of the bureau. Then, if you do not understand how to use a plane, read the article in No. 20 referring to this tool, and follow the same course with regard to others. By this means you will attain proficiency, and there is no other way, however tedious it may seem. I have answered you at some length, as, though you will see WORK is for workmen, every one must have a beginning, and I am pleased to see one so young as you taking an interest in useful mechanical pursuits. If you will suggest any little thing which might be described for the benefit of yourself and others similarly circumstanced, I will, if a description seems likely to be of general interest, try and arrange for a paper on it.—D. A.

Plough, etc., Plane.—H. S. (*Salisbury*).—Miller's combined plough, fillister, and matching plane is undoubtedly a useful tool, though whether you would find it more serviceable than the separate planes, which it supplies the place of, is more than I should like to say. It is really a point for you to decide for yourself. You are no doubt aware that combination tools, however ingenious, are seldom in every respect equal to all the various things they represent, their greatest advantage perhaps being that less space is occupied by having several things combined in one. As a matter of personal opinion, I prefer the various things combined in Miller's plough, etc., in their separate forms, and in saying this I do so without in the smallest degree reflecting on the efficiency of the combination. Were I constantly travelling about with a quantity of tools, when bulk would be a consideration, I should probably decide in favour of the combination. In case cost may have anything to do with your decision, it may be well to remind you that though the best tools separately would together be more than the combination, this is cosiderably more than you can obtain the lot in lower quality for.—D. A.

Brass Lacquer.—W. J. H. (*Oldham*).—I can hardly understand whether W. J. H. wants a recipe for the making of lacquer or for the application of the same to brass work. If the former, I would suggest that good lacquer can be bought in small quantities cheaper than it can be made by an amateur. But supposing W. J. H. wants it in large quantities, I will, however, try to meet his wants. As there are various colours required for different purposes, it would have been better had he said for what precise purpose he wanted it. 1½ oz. best pale shellac, 1 pint methylated spirit, 10 oz. silver sand, well washed, or powdered glass, put altogether in a bottle, and let stand for a day or two until the

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shellac is dissolved. It must be occasionally shaken. Let it now stand until quite clear—the fine sand in settling will carry down the other impurities—and pour off. A little spirit may be added to the sediment to dissolve out any remaining gum, and after settlement it may be added to the stock—this we will call No. 1. Take 1 oz. of dragon's blood dissolved in 1 gill of spirits, treating it in the same way as the other—this we will call No. 2. By adding this in small quantities to No. 1 we can get the depth of colour needed. The following recipe is given for philosophical instruments:—Gum gutæ 12 drachms; gum sandarach 2 oz.; gum elemi 2 oz.; dragon's blood 1 oz.; seedlac 1 oz.; terra merita 12 drachms; Oriental saffron 2 oz.; powdered glass 3 oz.; alcohol 20 oz. These must be dissolved and treated in the manner before described. The article to be lacquered must be polished until all scratches are removed, and then pickled in pickling acid, then removed and washed in hot water, and dried in boxwood sawdust. Care must be taken that no part is touched by the fingers, as if so every such mark will appear where lacquered. The article must be held in tissue paper of several thicknesses, and heated until it is warm enough to handle comfortably. The exact heat can only be learned by practice; indeed, the art of successful lacquering in all its stages is the result of much practice. The lacquer must be applied by a camel-hair brush in straight lines, and not painted on, and in no place must a second application be made over a previous one, at least until the first is hard.—O. B.

Silvering Glass.—W. J. H. (*Oldham*).—At present there are two principal modes adopted by the trade. First, the old-fashioned mechanical method of mercury and tinfoil; and, secondly, the chemical method. Now W. J. H. simply asks, "How to silver the back of a mirror?" If it is an average size mirror, I do not think he can do so at all, and if he could it would not pay him to do so, as the plant would cost more than the mirror when done. A perfectly level table, say, of marble is required, sufficiently large to take the glass, with a gutter to receive the superfluous quicksilver. But apart from the cost of plant, a great deal of practice is required to evenly distribute the quicksilver over the foil, and then to withdraw a sheet of paper which is placed between the amalgam and the glass. Small pieces of glass can, however, be silvered without much difficulty, as I have found when I have required such pieces, and could not purchase them. On a perfectly level surface—say, a mahogany table—spread a sheet of stout tinfoil; carefully rub out all creases. On this pour pure quicksilver. It is essential that it should be very clean; if there is any doubt about it it should be filtered by being squeezed through chamois leather. With a clean haresfoot distribute it evenly over the foil. Place a sheet of smooth paper on the amalgam, and lay the glass—having been made perfectly clean—on the paper; then, by a firm, steady pull, draw away the paper whilst retaining the glass in its position. By the withdrawing of the paper, what air or impurities may have been in contact with the amalgam will be swept off, and the amalgam and glass will be brought in close contact. It will be understood that no chemical action takes place between the two substances. They simply adhere by contact, and it is clear that if air or any impurity comes between them an unsilvered spot will be the result. The glass must now be placed under pressure for some hours, and then be tilted on its end to drain off the superfluous mercury. I presume this will be all W. J. H. requires. Should he, however, need the process of chemical silvering, I shall be glad to tell him all I know on the subject through "Shop."—O.B.

Book on Heating.—GREENOCK.—The following books may help you: "Warming and Ventilating," by J. W. Baldwin (Spon), 10s. 6d.; "Warming Buildings," a guide to the American practice of warming buildings by steam (Spon), 2s.; "Hot Water Apparatus," engineer's guide for fixing (Spon), 1s.—F. J. C.

Photo.—NO NAME (*Old Kent Road, London*).—There is no publication of the processes for alpha and self-toned paper, they being secret preparations. With respect to the others, "Abney's Instruction in Photography" will supply the necessary information. T. C. Hepworth's "Photography for Amateurs," 1s., Cassell & Co., is also a good book for beginners.—E. D.

Strings to Piano.—NEWSBOY (*Derby*) wishes to tune his piano and also to put on some new strings. The key he names is known in the trade as a tuning hammer. If he writes to W. Hughes, 37, Drury Lane, London, W.C., he can obtain the tuning hammer and the wire he requires. It would be better for him to cut some short pieces off the old strings and send them, then he would obtain the proper thickness. As to the tuning, there would not be space in this column to explain it, but NEWSBOY can order the "Pianoforte Tuner's Guide" through his local music seller. I think it is published at one shilling.—T. E.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Ink Bottles, Where to Purchase.—INK BOTTLE writes:—"I shall be much obliged if any reader of WORK will give me the name and address of any firm of whom I could purchase ink bottles, the same as one buys at shops filled with ink at one penny each."

Small Metal Wheels, Where to Buy.—METAL WHEELS asks:—"Can any reader inform me where I can obtain, either wholesale or retail, small metal wheels, such as are used for wooden horses, engines, and waggons, that we see at our various toy shops?"

Hammered Iron Work, Lessons in.—HIGHBURY wishes to know of any one or any book that would give lessons in the hammered iron or wrought iron work which you see so much about now, or of any school or institute where he could learn it in the evening.

Patterns for Wheel Guards.—CONSTANT READER asks:—"Will any reader tell me the best and quickest method of getting patterns for tin wheel guards for bevel cog wheels for machinery, and shafts both large and small?"

Fluid Cement for Roller Leather.—T. W. R. (*Royston*) writes:—"I shall be glad if any reader of WORK will give directions how to make a fluid cement which will fasten and hold together what is known as 'roller leather,' and harden as quickly as possible."

Attachment of Seams of Waterproof Garments.—A CONSTANT READER asks:—"Will any correspondent oblige me with a receipt for the material with which the seams of waterproof garments are held together?"

Cork Heel, etc.—J. R. writes:—"I shall be much obliged if NITRAM (*Boscombe*) or any other subscriber to WORK would tell me how to make up a cork heel with leather high and small fitting stuff; how many lifts and split lifts; how many to peg down or sew proper place slope in, and draw out at top piece to fit the last to make the heel level with the sole; also flat and medium height; also the draught of shank irons, men's and women's."

Gas Stove, Sketch for.—S. P. (*West Bromwich*) writes:—"I have a lecture room 30 ft. by 14 ft. which I wish to heat with two gas stoves. Can any reader give me a sketch of a good gas stove that I could make myself, with advice as to what kind of burners are required?"

Band Saws.—S. B. (*Nottingham*) writes:—"I have been much pleased with the instructions I have gained from WORK on circular saws. I should be very much obliged if some reader will give a few instructions on band saws, and the cause of their breaking, as I find they often break after one has sawn through the wood. I should also like some instructions on brazing saws."—[Will A. R. (*Scorrier*) oblige, and will he also kindly send me his full name and address?—ED.]

Zither.—J. C. (*Barnsley*) asks for the title of any book that will give instructions how to make a zither?"

Working Drawing of Tram Car.—J. W. F. (*Lancaster*) writes:—"Will any correspondent kindly tell me where I could write for a working drawing of a London tram car with seats on top and spiral staircases? I would pay a good price for a proper plan."

Horse Power of a Windmill.—SCRUTINEER wishes to know how to calculate this.

Packing Case Making.—STUART (*Edinburgh*) will be thankful for any information as to mode of conducting above business on usual trade terms.

Lacquer for Iron and Steel, etc.—STEEL writes:—"There is a blue lacquer, which is used for iron and steel and cheap tin toys, etc., the preparation of which, or where it is to be had, I should like to learn from some reader."

Dies for Taper Tubes.—T. R. (*Gateshead*) writes:—"I should like to know of what material the dies are made of for drawing taper tubes through."

Scotch Glue.—S. J. H. (*Skipton*) writes:—"I should like to know if there is anything to get to make Scotch glue white, so as it will not leave a dark line in the joints of light wood. I shall be pleased if some of our readers could tell me what it is, and where it could be got, and I will do my best to help any one if anything appears that I can solve for any of our readers. Will you kindly put the question in corner of 'Shop?'"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Insurance of Tools.—G. S. (*Aberdeen*) writes:—"In looking over 'Shop,' in that very good paper WORK, I was rather astonished to see a question put regarding insurance of tools. In Aberdeen here it is not only possible to insure tools, but it is a difficulty to avoid doing it. There is the Northern Assurance Co. here whose agents go through the workshops to try to get the workmen to insure their tools in that company. And in fact there is only one way to get rid of their persistent calls, and that is to say that your society insures your tools. Of course that company may not have a branch in the place where your correspondent's domicile is situated, but I think any insurance company would insure tools if asked to do it. The rate for insuring tools here is 3d. per £1, or 2s. 6d. for £10 per annum. That is in a cabinet maker's or joiner's workshop. Do not think, because I say workmen in shops, that amateurs cannot insure their tools. They can, if they like. The agent just comes and inspects the place where the tools are and its surroundings, and puts the usual queries as to how many are to work there, and number of fires to be used, etc., and if satisfied grants policy. Of course that rate is much higher than that for ordinary house property, but then the risk is much greater on account of the shavings and wood that is always about in a workshop."

Trade Notes and Memoranda.

AT the half-yearly meeting of the Forth Bridge Railway Company held at Edinburgh, Lord Colville, who presided, said that the bridge was approaching completion. The great cantilevers were practically finished, and the central girders were being put into position. The directors hoped to be able to walk over the bridge this month, and if the approach lines were sufficiently advanced, Lord Colville thought that they would be able to use the bridge for goods and mineral traffic early in 1890.

OUR readers may remember the gallant deed of John Smith in May last, who, at imminent risk to his own life, rescued a fellow workman from being roasted alive by a great Siemens steel ingot in the casting pit of the Norfolk Works, Sheffield. The rescued man died afterwards in the infirmary, and John Smith is only now recovering sufficiently to give hope of returning to work. But his bravery has been brought under the notice of the Home Secretary by Commander Smith, and the result is that the hero of Norfolk Works has been granted a second-class Albert medal, which was presented to him by the mayor in the presence of his fellow-workmen. A purse of gold (£20 17s. 9d.) collected by the workmen and £25 added by the firm was also given to the gallant John Smith.

AT present the steel pen trade of Birmingham is flourishing. The weekly average production exceeds 160,000 gross, which consumes from 16 to 18 tons of steel. Of this quantity only about 8 tons appear in the manufactured article, the rest being loss or waste.

THE Swedish export trade in woodwork is steadily increasing, the value of the articles exported last year being £95,000, as against £80,000 in 1887. The chief ports of export are Gothenburg, with £70,000, and Stockholm with £20,000. The largest consumer is Great Britain, with £51,000, being followed by Holland with £10,000, Prussia, £8,000, and France and Belgium with £2,000 each. The export to the Cape was £1,000, and to Australia £700.

PROFESSOR GUNNING estimates the average amount of water passing over the Niagara Falls per minute at 18,000,000 cubic feet. Allowing 62½ lbs. to the cubic foot, this would give a total of 562,500 tons per minute, of which somewhat more than two-thirds would pass over the Horse Shoe Falls.

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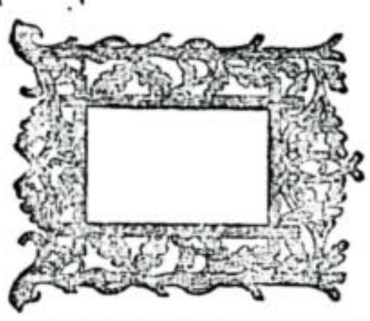

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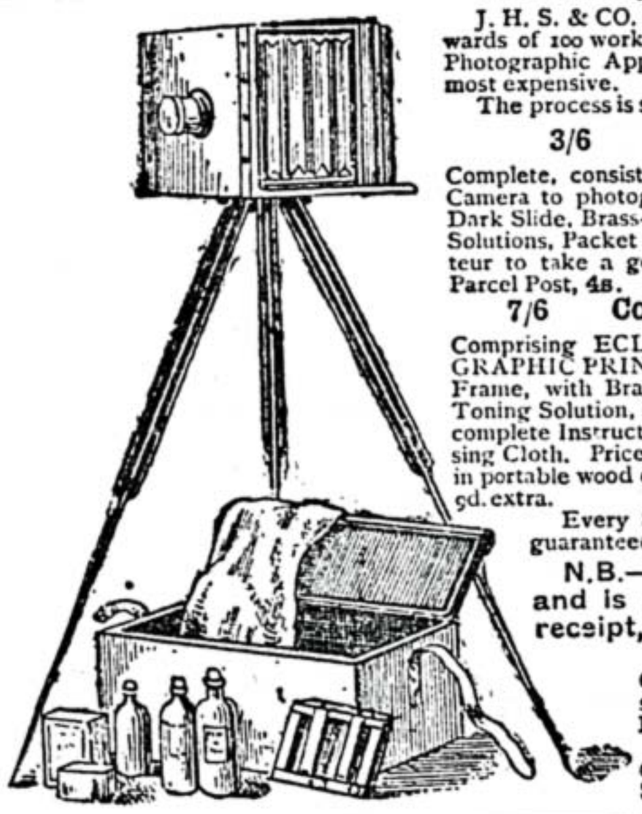

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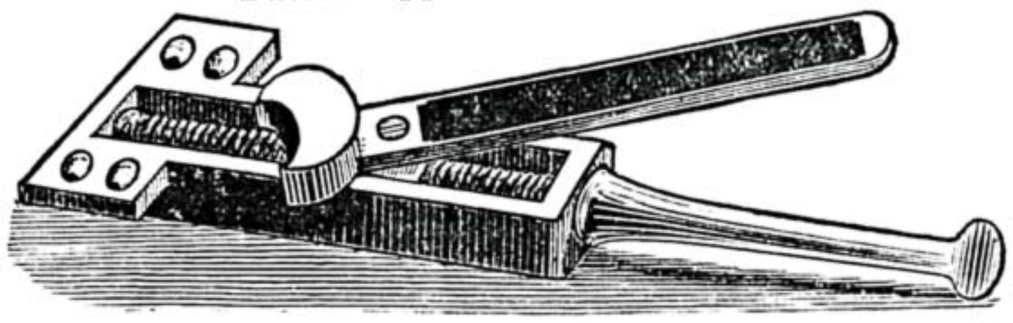

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